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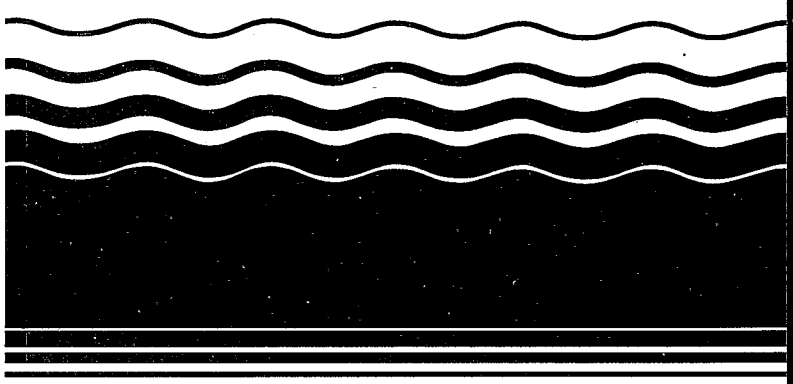
EPA

The Superfund Innovative Technology Evaluation Program

Annual Report to Congress FY 1997

SITE

SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION



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Office of Solid Waste and Emergency Response
and
Office of Reasearch and Development
U.S. Environmental Protection Agency
Washington, DC, 20460

Notice

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Foreword

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the nation's land, air, and water resources. Under a mandate of national environmental laws, the EPA strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet these mandates, EPA's research program, through its National Risk Management Research Laboratory (NRMRL) and National Exposure Research Laboratory (NERL), provides data and technical support for solving environmental problems, and is building a science knowledge base necessary to wisely manage our ecological resources, understand how pollutants affect our health, and prevent or reduce future environmental risks.

NRMRL is the EPA's center for investigating technological and management approaches for reducing risks from threats to human health and the environment. NRMRL's research program focuses on methods for preventing and controlling pollution to air, land, water, and subsurface resources; protecting water quality in public water systems; remediating contaminated sites and groundwater; and preventing and controlling indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

NERL is EPA's center for investigating technical and management approaches for identifying and quantifying risks to human health and the environment. Goals of NERL's research program are to (1) develop and evaluate methods and technologies for characterizing and monitoring air, soil, and water; (2) support regulatory and policy decisions; and (3) provide the science support needed to ensure effective implementation of environmental regulations and strategies.

This publication has been produced as part of EPA's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

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Executive Summary

The Superfund Innovative Technology Evaluation (SITE) Program has been successfully promoting the development, commercialization and implementation of innovative hazardous waste treatment technologies for more than 10 years. SITE offers a mechanism for conducting joint technology demonstration and evaluation projects at hazardous waste sites involving the private sector, EPA, and other federal and state agencies. The program provides environmental decision-makers with relevant data on new, viable remediation technologies that may have performance or cost advantages compared to conventional treatment technologies. Since the initiation of the SITE Program in 1986, cleanup of contaminated sites through the use of innovative technologies has resulted in a total discounted cost savings of over 680 million dollars.

During fiscal year (FY) 96, the SITE Program reviewed its approach to doing business and determined that operational shifts in the program were necessary to identify and assist in the development of the most sought-after technology types and treatment methods. Building on the strengths of the existing program, such as demonstration design, quality assurance, and technology transfer, the SITE Program shifted in FY97 from a technology-driven focus to a remediation problem focus, driven by the needs of the hazardous waste remediation community. The SITE Program has the following four operating functions: (1) program planning, (2) matching priority sites with innovative cleanup solutions, (3) technology field demonstrations, and (4) information dissemination. The SITE Program's vision of the program is to remain the premiere organization in enhancing the credibility and implementation of effective innovative remediation options.

The SITE Program continues to earn increased recognition as a leader in advancing innovative technology development and commercialization. The program is participating with more than 94 hazardous waste sites and 114 technology developers. Due to an unusual budgetary year, the annual SITE Program solicitation was not announced during FY96, and only ongoing field projects initiated prior to FY96 were completed. Through FY97, the SITE Program has successfully demonstrated 95 technologies, nine of which were completed during FY97, with four new innovative technologies evaluated in the field. Emphasis formerly placed on technologies requiring the removal of soil or groundwater (*ex situ*) is gravitating to *in situ* technologies that treat contamination in place. The SITE Program recognized this change and has emphasized the development of *in situ* technologies. Of the 21 ongoing or planned demonstrations, 15 are *in situ*, while only six are *ex situ*.

To ensure that the Program continues to meet the needs of the remediation community, the SITE Program established a remediation stakeholder group. This group, which is composed of such agencies as the Department of Defense and the Department of Energy, reviews innovative technology applications and develops an environmental emphasis area list, which ensures that the most pressing issues are prioritized and addressed. For instance, from discussions with various governmental and private groups, SITE's Monitoring and Measurement Technologies (MMT) Program identified a need for more effective methods to evaluate soil contamination. In response to this need, the MMT

Program conducted demonstrations of four soil sampling technologies and two soil gas sampling technologies in FY 97. Through such relationships with other interested parties, the SITE Program continually pursues opportunities to conduct cooperative technology demonstrations, thereby reducing expenditures and further promoting innovative technologies. These factors assist the SITE Program in attaining its primary goal – the expedited cleanup of the nation's most contaminated sites.

SITE Program Overview

Introduction

The EPA's SITE Program has successfully promoted the development, commercialization, and implementation of innovative hazardous waste site remediation and characterization technologies for more than 10 years. The SITE Program is composed of a Demonstration Program, a Monitoring and Measurement Technology (MMT) Program, and information transfer. The SITE Program formerly included the Emerging Technology Program (ETP), which was discontinued in 1996. SITE offers a mechanism for conducting joint technology demonstration and evaluation projects at hazardous waste sites through the involvement of the private sector, EPA, and other federal and state agencies. Commercialization of innovative technologies is assisted by providing potential users with high quality, unbiased performance and cost data. SITE also promotes commercial application of innovative technologies through an extensive technology transfer program.

Program Improvements

To reduce expenditures and to remain at the forefront of innovative technology development, the SITE Program reviewed its approach to doing business in fiscal year (FY) 1996. The review indicated that operational shifts in the program were necessary to identify and assist in the development of the most sought-after technology types and treatment methods. Building on the strengths of the existing program, such as demonstration design, quality assurance, and technology transfer, the SITE Program shifted in FY97 from a technology-driven focus to a remediation problem focus, driven by the needs of the hazardous waste remediation community. EPA's vision of the SITE Program is to remain the premiere organization in enhancing the credibility and implementation of effective innovative remediation options.

The SITE Program is now defined by the following four operating principles: (1) program planning, (2) matching priority sites with innovative cleanup solutions, (3) technology field demonstrations, and (4) information dissemination.

Program Planning

To ensure that the SITE Program continues to focus on validating the most sought-after remediation technologies, overall program direction and strategies are now evaluated each year based on input from the user community and other private and public-sector stakeholders. As part of the overall program planning process, the SITE Program is developing and will implement a quality management plan based on American National Standard Institute, Specifications and Guidelines for Quality Assistance for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E4).

Matching Priority Sites with Innovative Cleanup Solutions

The SITE Program formerly identified innovative technologies, and then searched for an appropriate demonstration site. The SITE Program now solicits and prioritizes sites, and then seeks appropriate technologies for

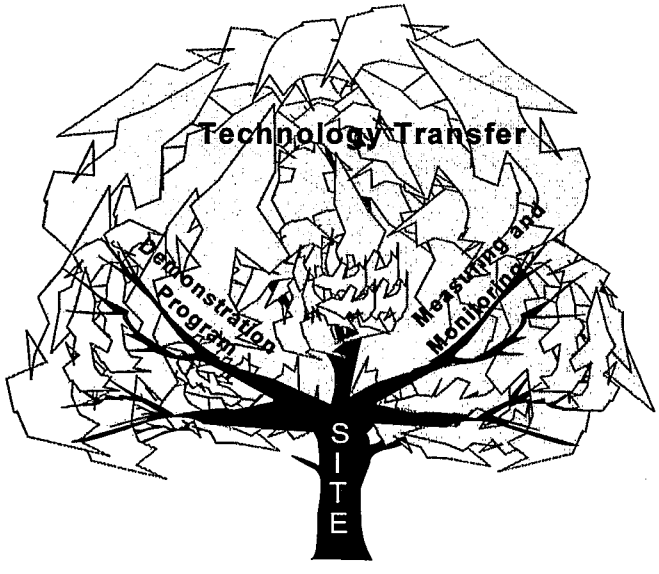
demonstration at these sites. Matching a site with a technology is a flexible process, and a site has the option of evaluating one or more technologies. If no specific technology or vendor is identified by a chosen site, technologies and vendors are matched to sites by the SITE Program and other interested parties, which may include state and federal regulators and other public representatives.

An important aspect of technology selection is that more than one technology may be introduced for review and demonstration. This allows for matching the most appropriate and feasible technology to a particular site. General technology needs of the user community are identified by soliciting input from working groups, forums, personal communication, and hazardous waste publications. With this continuous input, the SITE Program will continue to focus on the needs of the remediation community and the more pressing problems at contaminated sites.

Technology Field Demonstrations

Field demonstrations are conducted to provide quality data to evaluate technology performance. The resulting data and reports are intended for use by the site owners and state and federal decision-makers in evaluating remediation options and for adding credibility to technology vendors promoting their processes.

SITE Program technology demonstrations are increasingly conducted in partnership with other EPA offices, other federal agencies, states, private industry, and universities. These partnerships not only reduce the overall costs of demonstrations to EPA, but accelerate remediation of some of the most problematic sites at federal facilities. One example of these partnerships is the Rapid Commercialization Initiative (RCI) Program, sponsored by the U.S. Department of Commerce, which conducts cooperative technology demonstrations to assist various agencies in streamlining policies and strategies for technology commercialization.



The SITE Program is participating in a technology demonstration under the RCI Program that is also supported by the U.S. Departments of Energy (DOE), Defense (DOD), and the California Environmental Protection Agency.

Information Dissemination

As part of its improvement process, the SITE Program recognized the need for expediting the progression of demonstration data from the laboratory to the user community. The expansion of its electronic information sources was identified by the SITE Program as the most effective means for accomplishing this task. As a result, the amount of information on innovative technologies available through electronic sources is growing at a rapid pace, with the World Wide Web as the primary conduit.

The development of technical documents within the SITE Program is a dynamic process, with a continual drive towards presenting data in its most usable form. A primary product of this effort, which was improved in FY97, is the summarization of information on a variety of technologies or applications for a specific area of interest. This information allows the user community to compare the technical capabilities of these technologies, expected cost for the application, and the compliance of the technology with regulatory guidelines.

Meetings and conferences continue to be an important factor in the dissemination of technical information generated by the SITE Program and were utilized to their full potential during FY97. These forums offer face-to-face discussion among the user community, technology developers, and the SITE Program, which serves to generate ideas for future development and use of innovative technologies.

Program Description

SITE is a partnership between the public and private sectors, where the costs and responsibilities are shared by EPA, hazardous waste site owners, and technology developers. EPA enters into cooperative-type arrangements with site owners and technology developers, under which innovative technologies are demonstrated at selected hazardous waste sites. EPA evaluates the new technologies based on the demonstration results, and compiles and publishes engineering, performance, and cost data intended to aid in decisions regarding the use of the technologies at similar hazardous waste sites. The program generates credible and unbiased technology cost and performance data needed by remedial project managers, consultants, and other environmental decision makers. EPA promotes easy access to this information, allowing project manager to make timely decisions in selecting cleanup remedies.

Historically, one of the greatest factors inhibiting the use of innovative cleanup technologies has been the lack of adequate and credible cost and performance data during technology development at or near the commercial scale. Understandably, many site owners are unwilling to risk the use of innovative technologies without assurance of the technology's success. By addressing this need, SITE has aided in the first-time field use of many technologies, often resulting in wide acceptance of a particular technology. Providing credible, unbiased cost and performance data remains the foundation of SITE.

Program Design

The SITE Program is comprised of the following key elements:

✓ ***Demonstration Program***
Evaluates and verifies cost and performance of promising innovative technologies at selected hazardous waste sites to provide reliable performance, cost, and applicability information for site cleanup decision-making

✓ ***Monitoring and Measurement Technology Program***
Evaluates technologies that detect, monitor, and measure hazardous and toxic substances to provide more cost-effective methods for producing real-time data during site characterization and remediation

✓ *Information Transfer Activities*
Disseminate technical information, including engineering, performance, and cost data, to assist in removing barriers for use of innovative and alternative technologies

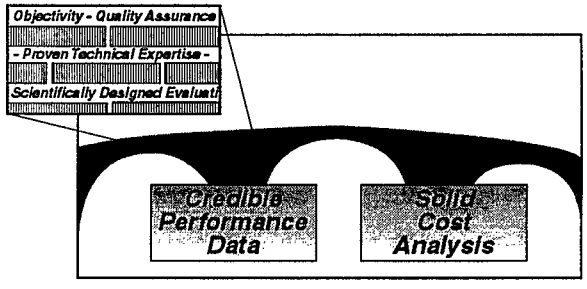
Demonstration Program

In the Demonstration Program, innovative cleanup technologies are field tested on hazardous waste materials. SITE demonstrations are conducted at hazardous waste sites, such as those on the National Priorities List (NPL); Brownfields at non-NPL sites; or under simulated hazardous waste site conditions at developer or federal test and evaluation facilities. Engineering, performance, and cost data are gathered on innovative technologies for review by potential users to evaluate their applicability to similar waste sites or to compare their effectiveness and costs to other alternatives. Data collected during each field demonstration are used to assess the performance of the technology, the potential need for pre- or post-processing of the waste, applicable types of wastes and contaminated media (for example, soil, sludge, water, sediment), potential operating problems, limitations, and approximate capital, operating, and maintenance costs.

The SITE Program annually solicits applications for participation in the Demonstration Program from interested private firms and federal and state agencies with responsibility for cleanup operations at hazardous waste sites. Cooperative arrangements or Memoranda of Understanding form the relationship between the SITE Program and the parties responsible for the host site. No contractual agreement is arranged and no funds are given to the site as part of this arrangement. SITE provides in-kind service in the form of technical demonstration, testing, sampling/ analytical services, and report writing.

The selection of sites for the program is based on the research needs of EPA, other federal agencies, and the technology user community.

Host site owners (see Appendix B for sites categorized by state and location) are responsible for providing necessary data related to the hydrogeology and other site conditions, results of feasibility studies, and results of waste analyses. The host site also is responsible for all logistical requirements for the demonstration, such as availability of utilities, access to land area at the site large enough for equipment setup, elimination or restriction of geographical or geological hindrances, security provisions, and personnel safety provisions. Technology developers whose systems are demonstrated are responsible for transporting equipment to the selected site, operating their systems, and removing equipment from the site upon completion of the demonstration.



EPA is financially and technically responsible for project planning, sampling and analysis, quality assurance and quality control, preparing evaluation reports, and disseminating cost and performance information to environmental managers. EPA also prepares bulletins, project summaries, and videos to document demonstration activities. These reports and videos evaluate available information on the technology and analyze its overall applicability to other site characteristics, waste types, and waste matrices. Reports also include testing procedures and the quality assurance and quality control standards.

As of September 30, 1997, the Demonstration Program included 116 accepted,

ongoing, and completed demonstrations. These technologies are presented alphabetically in Appendix A, according to the state in which the developer's business is located.

Monitoring and Measurement Technology (MMT) Program

The MMT Program provides developers of innovative hazardous waste measurement and monitoring technologies with an opportunity to demonstrate a technology's performance under actual field conditions. Following the demonstration, EPA compiles the results and prepares a report summarizing the findings. Report distribution may enhance market acceptance or define new applications for the technology.

The purpose of the MMT Program is to accelerate the acceptance and use of effective innovative measurement and monitoring technologies in the field. These technologies include new or modified technologies that can detect, monitor, and measure hazardous and toxic substances in the subsurface, soil, sediment, waste materials, and surface waters. Technologies include chemical sensors for *in situ* (in place) measurements, groundwater sampling devices, soil and core sampling devices, soil gas or fluid samplers, laboratory and field-portable analytical equipment, and other systems that support field sampling or data acquisition and analysis.

MMT Program technologies can be used to accurately assess the degree of contamination at a site, provide data to evaluate potential effects on human health and the environment, supply data to assist in selecting the most appropriate cleanup action, and monitor the effectiveness of a remediation technology. The selection process places high priority on technologies that provide more cost-effective, faster, and safer methods than conventional technologies for producing real-time or near-real-time data. Innovative technologies are demonstrated under field conditions and results are compiled, evaluated, published, and disseminated by ORD. The primary objectives of this portion of the SITE program are:

- Test field analytical technologies that enhance monitoring and site characterization capabilities
- Identify the performance attributes of new technologies to address field characterization and monitoring problems in a more cost-effective and efficient manner
- Prepare protocols, guidelines, and methods that enhance the acceptance of these technologies for routine use

Evaluations or demonstrations have now been completed for over 30 technologies. The MMT Program is administered by ORD'S National Exposure Research Laboratory at the Environmental Sciences Division in Las Vegas, Nevada. Technologies demonstrated under the MMT Program are listed in Appendix A.

Information Transfer Activities

Information transfer activities ensure that valuable information on innovative technologies from the Demonstration and MMT Programs is disseminated through various communication mechanisms such as technical networking, publications, and electronic distribution. The most important products are the published technical reports for each field demonstration. All such activities increase awareness of, and promote the use of, innovative technologies for assessment and remediation at Superfund sites. The primary goal of information transfer is to promote communication among environmental stakeholders requiring up-to-date technical information.

Mechanisms for providing information on technology demonstrations and the SITE Program include the following:

- Program-specific brochures and exhibits
- Conferences, workshops, and technical working groups

- Publications and video tapes (see Appendix C)
- Electronic media, including the Internet and electronic bulletin boards
- Technical assistance to regions, states, and remediation contractors
- Technology seminars

Printed and electronic documents are accessible through the World Wide Web at the Environmental Technologies Verification (ETV) Web site (*http://www.epa.gov/etv*) and at another site supported by the EPA Office of Solid Waste and Emergency Response's Technology Innovation Office (*http://clu-in.com*).

Several technology databases summarize information on innovative treatment technologies and associated vendors. These databases may serve as tools in identifying potential technology demonstration candidates or serve as a directories for technology vendors. Examples of these databases include, but are not limited to, Vendor Information System for Innovative Treatment Technologies (VISITT), Vendor Field Analytical and Characterization Technologies System (Vendor FACTS), and the Bioremediation in the Field Search System (BFSS). This information is accessible through the internet at the SITE Homepage (*http://www.epa.gov/ORD/SITE/*) or the Office of Solid Waste and Energy Response (OSWER) Technology Innovation Office (TIO) Homepage (*http://www.clu-in.com*). Descriptions of the databases and publication ordering information are provided in Appendix D.

SITE Program Cost Savings and Vendor Accomplishments

Promotion of Innovative Technologies

SITE is recognized as one of EPA's principal programs to advance innovative site monitoring, characterization, and cleanup technologies, with the potential to treat hazardous wastes more efficiently, less expensively, and more safely than many existing methods. SITE's mission is to promote the development and application of innovative technologies that reduce or eliminate risks to human health and the environment due to contamination. The goal of the program is to interact with the technology user community, understand its needs, integrate those needs with EPA's research mission, and expeditiously address those needs. Identifying and responding to the technology needs of the remediation community is the driving force behind today's SITE Program.

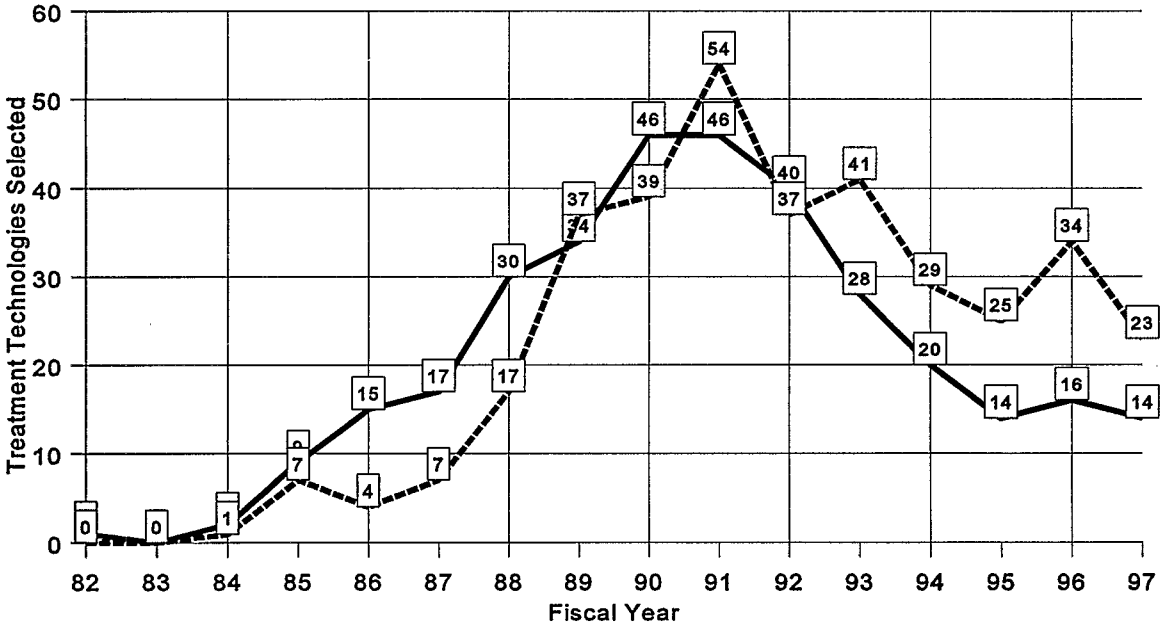
Over the past 10 years, SITE has earned increased recognition as a leader in advancing innovative technology development and commercialization and is currently participating cooperatively with more than 94 hazardous waste sites and 114 technology developers. Through FY97, the SITE Program has successfully demonstrated 95 technologies, nine of which were completed during FY97. These demonstrations have provided a tremendous amount of information on the performance, costs, and applicability of innovative cleanup technologies, which greatly assists managers of environmental remediation projects in developing appropriate and effective cleanup solutions.

Innovative Technology Use Has Increased Due to the SITE Program

The types and numbers of innovative technologies selected for remediation at Superfund sites were increased significantly after the passage of SARA. While rarely used during the early 1980s, innovative technologies comprised approximately one-quarter of the total number of technologies selected for Superfund remediation projects between FY86 and FY87. Since then, the number has continued to rise, indicating increased credibility for and confidence in a number of innovative treatment technologies. Figure 1 shows that more innovative technologies were selected in Records of Decisions (RODs—official records documenting selection of Superfund site cleanup methods) signed during FY93, FY94, and FY 95 than established technologies. Although SITE is only one contributing factor in increasing innovative technology selection, the program has played a significant role in this activity.

Historical Program Cost Savings and Vendor Contracting

Since its establishment in 1986, the SITE Program has assisted in the development and use of innovative technologies, resulting in substantial cost savings for cleaning up contaminated sites. The SITE Program has assisted vendors in advancing innovative technologies from the development phase to full-scale application, and has promoted greater acceptance of these technologies. The following subsections provide examples of the financial success of the SITE Program.



(1) Data based on Records of Decision (ROD), except on-site incineration data, which are based on anticipated design and construction activities as of September 1997.

(2) Data based on anticipated design and construction activities as of September 1997. A site may use more than one technology.

Figure 1. Innovative vs. established treatment technologies by year. (Source: U.S. EPA, Office of Solid Waste and Emergency Response, Technology Innovative Treatment Technologies: Annual Status Report, Eight Edition, EPA/542/r-96/010, November 1997.)

SITE Program Accomplishments

The SITE Program has been estimating program cost savings since 1993. During 1996, the SITE Program collected information from signed RODs (dated 1993-1995) in all 10 EPA Regions that selected an innovative technology as the remedy. This time period was selected for evaluation because more innovative technologies than conventional technologies were selected in RODs signed in each of these years, with a total of 95 innovative technologies used (Figure 1). Of the 95 RODs that selected innovative technologies, 46 used technologies evaluated in the SITE Program. Data compiled by the SITE Program allowed environmental managers to compare innovative technologies to conventional technologies, especially with respect to cost. Cost savings realized by using innovative technologies for the 46 RODs was estimated at $1.4 billion, with an average percent savings per site of 70 percent. Only six of the 46 RODs reported that the innovative technology was more expensive than the established technology. The RODs in this data set may represent particularly difficult cleanup problems as the cost savings per ROD were found to be higher, on average, than the cost per ROD throughout the Superfund Program.

To estimate SITE Program net benefits, the 1993-1995 RODs and the SITE Program budget were first inflated to the end of 1996 using CPI figures and then normalized to 1986

end-of-year levels using a 7 percent discount rate, as specified in Office of Management and Budget-Circular A-94. The 1986 date was selected as the baseline since the SITE Program was initiated in 1986. The total discounted cost savings for RODs from 1993-1995 was $780 million. For comparison, the total discounted SITE Program budget from 1986-1996 was $100 million. This comparison represents an estimated cost savings of over $680 million for various site cleanups.

Figure 1 also indicates the number of innovative versus established treatment technologies selected by year. This figure shows that by the early 1990s, the interest in innovative technologies as a sound remediation action was increasing. Since 1993, the use of innovative technologies has outpaced that of established technologies, resulting in dramatic cost savings.

Historical Vendor Accomplishments

Technology vendors are central part of the SITE Program, providing services for sites requiring clean-up solutions. Vendors experience various benefits by participating in the SITE Program, namely increased market and acceptance of innovative technologies is demonstrated by the level of commercial activity experienced by SITE Program vendors. For example, a 1994 vendor survey indicated that commercial vendors completing SITE demonstration projects reported 533 contract awards comprised of 395 non-Superfund and 138 Superfund jobs. Seventeen percent of the vendors conducted international activities through independent commercial contracts or joint ventures. Figure 2 provides a breakdown of these jobs.

As part of a SITE Program evaluation in 1996, 77 vendors were questioned regarding company revenues. Roughly 50 percent of the respondents claimed a 20 to 75 percent increase in revenues as a result of SITE Program involvement. Following participation in the SITE Program, most vendors were awarded from one to five Superfund remediation jobs and one to five non-Superfund remediation jobs. For 1996, 30 percent of the SITE Program vendors reported one to two international contracts, nearly doubling the 17 percent of 1994. Respondents identified 20 countries where bids were submitted.

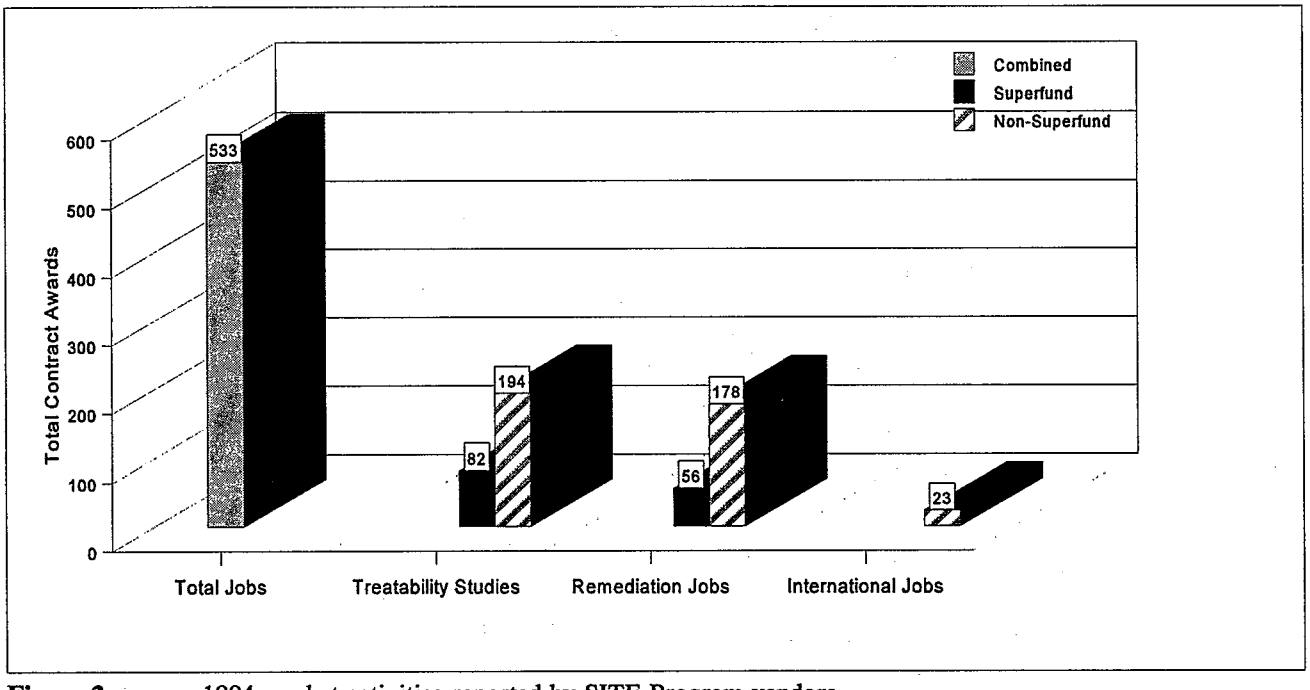


Figure 2. 1994 market activities reported by SITE Program vendors.

From 1990 through mid-1996, 51 technology vendors involved in the SITE Program reported 1,895 contract awards. Most of these contracts involved remediation projects at non-Superfund sites (see Figures 3 and 4).

Agency Science Advisory Board Review

During FY97, the Environmental Engineering Committee (EEC) of EPA's Science Advisory Board (SAB) published a report detailing its formal review of the SITE Program

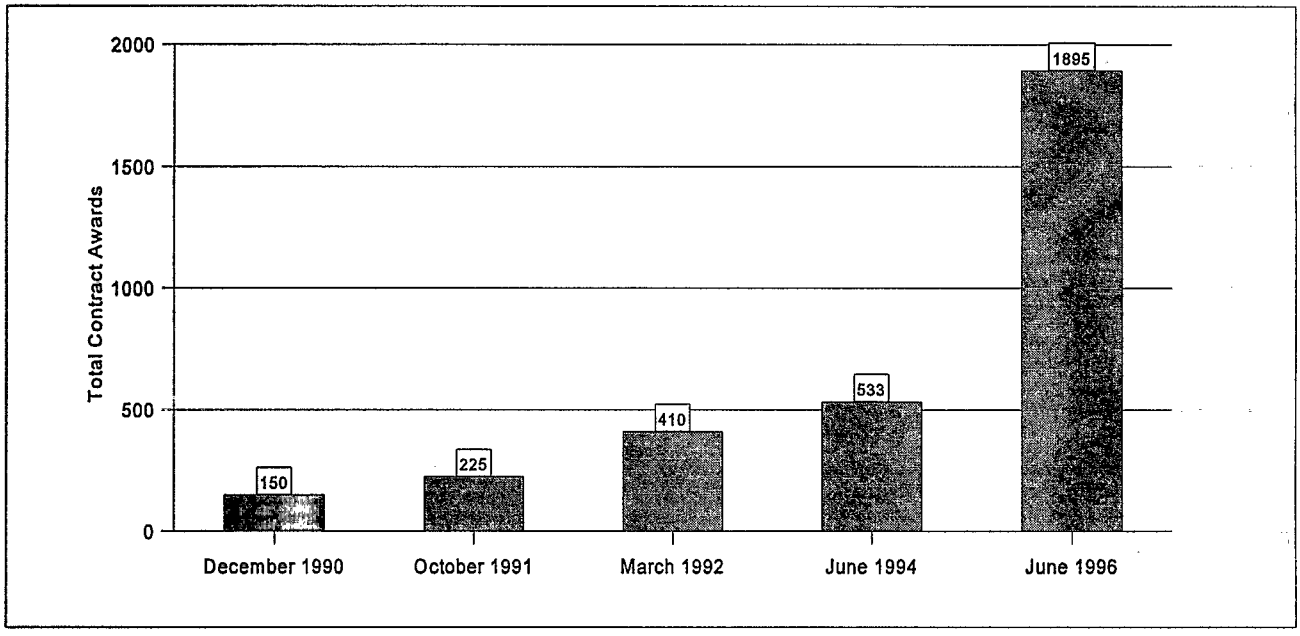


Figure 3. 1990-1997 remediation contracts by SITE technologies (cumulative).

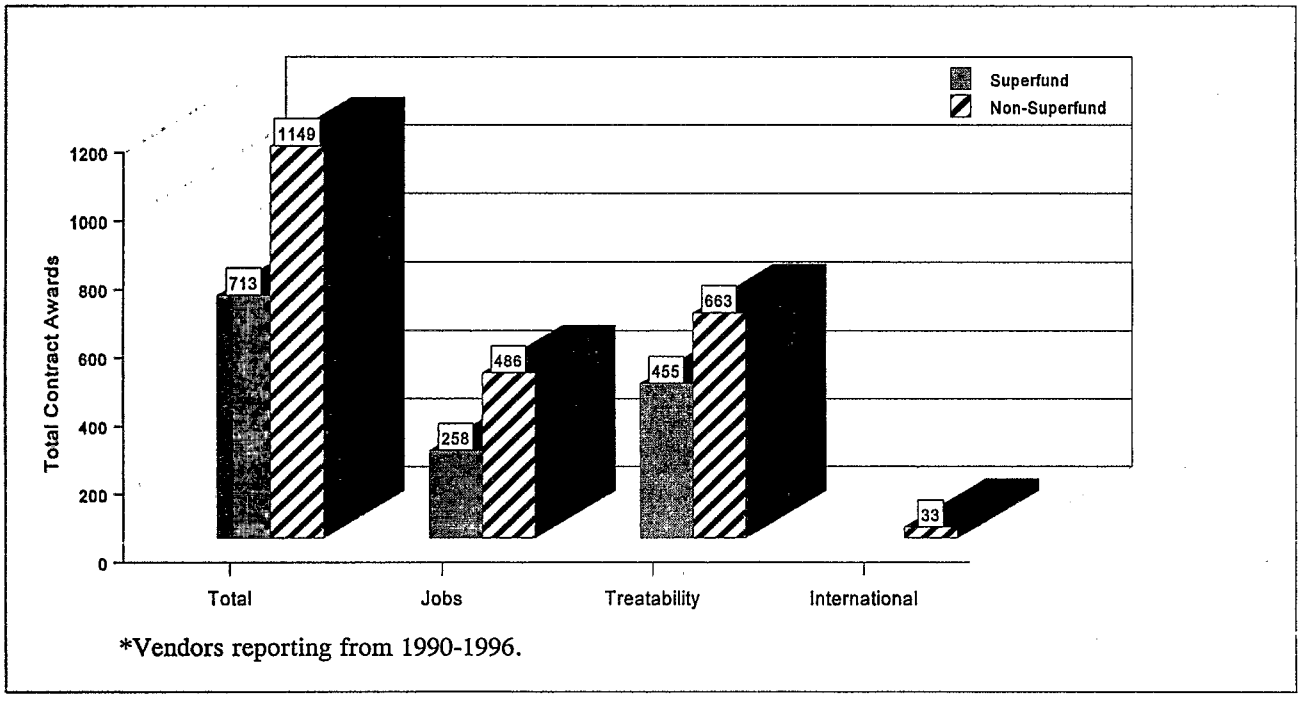


Figure 4. Historical market activity reported by SITE Program vendors.

during FY96. EEC's review primarily focused on the following:

- The extent to which stated program objectives were met
- Scientific and technical aspects of the program
- Impacts of the program and recommendations for potential improvements
- The extent to which the program has supported innovative technology commercialization

The SAB report on the SITE Program indicated that:

- (1) Program objectives were generally met or exceeded, and the program provided credible information on innovative technologies, many of which are in use at Superfund or RCRA corrective action sites

- (2) The SITE Program has become a model for other technology verification programs, such as the Environmental Technology Verification Program, and has coordinated joint technology evaluations with DOD and DOE

- (3) The SITE Program should be built upon by improving various aspects of the program in order to meet the need for improved technologies which prevent, reduce, or remediate environmental contamination.

Innovative Technology Highlights

SITE Program Case Studies

This section presents case studies of innovative remediation technologies for vendors that have participated in the SITE Program through either the Emerging Technology Program (Case Studies 1 through 3) or the Demonstration Program (Case Studies 4 through 6). The case studies provide brief descriptions on the use and status of various technologies and, where available, general information on the cost of applying each technology. These case studies represent the SITE Program's approach to promoting innovative technologies by identifying user needs. For example, acquiring sufficient funding for site remediation through conventional means can prove difficult. Therefore, demonstrations involving low-cost technologies are always of great interest. Phytoremediation (see Case Study 2), which involves the use of plants to address contamination in soil, is a popular research subject at present due to its obvious potential for low implementation and maintenance costs. Oily contaminated liquids spilled onto concrete surfaces are difficult to cleanup, limiting the future use of buildings with this type of contamination. Case Study 6 provides the details on a technology capable of removing these materials from concrete down to a few inches below the surface, through a low-cost, simple application.

The technologies presented in these case studies are typical of the SITE Program and represent SITE's remediation problem focus, driven by the needs of the hazardous waste community. These technologies represent real or potential solutions to cleanup problems.

Case Study 1: Adsorption-Integrated-Reaction Process (KSE, Inc.)

The Adsorption-Integrated-Reaction Process (AIR-II) is used to treat air streams contaminated with dilute concentrations of chlorinated and nonchlorinated volatile organic compounds (VOC) through adsorption and photocatalytic oxidation. The AIR-II system yields lower total system costs than either thermal incineration or catalytic oxidation, and is self-contained and mobile.

In the AIR-II system, contaminated air is directed into a photocatalytic reactor, where VOCs bind to the surface of a catalytic adsorbent that is continuously illuminated by ultraviolet light. With oxygen present in the surrounding air acting as a reactant, VOCs are destroyed by enhanced photocatalytic oxidation.

Treated air exiting the photocatalytic reactor contains water and carbon dioxide. Hydrogen chloride and limited amounts of chlorine may be present in the treated air if chlorinated VOCs are treated. These contaminants can be removed using conventional adsorbents and scrubbers. The catalytic adsorbent used in the AIR-II system is regenerated by the system and, unlike traditional carbon adsorption, does not require removal or disposal for regeneration.

Waste Applicability

The AIR-II process is capable of destroying a variety of VOCs, including aromatic and aliphatic hydrocarbons, alcohols,

ethers, ketones, aldehydes, and chlorinated hydrocarbons. AIR-II can be used to treat VOCs present in air at concentrations ranging from less than 1 part per million (ppm) to thousands of ppm. The process also can be used in conjunction with several existing technologies (soil vapor extraction, thermal desorption, or air stripping) to treat media other than air including soils, sludges, and groundwater.

Status

Because of its potential to dramatically reduce the costs of treating air streams containing VOCs, the AIR-II process was accepted into the SITE ETP in 1995. A pilot-scale evaluation of the technology was conducted at Loring Air Force Base as part of a soil vapor extraction operation to remove perchloroethylene. The destruction efficiency of perchloroethylene during the demonstration was greater than 99.8 percent. Performance results were presented at the 1996 World Environmental Congress. KSE's AIR-II process was admitted into the Demonstration Program in FY97, and a full-scale demonstration will be conducted in FY98.

Case Study 2: Phytoremediation of Contaminated Soils (Phytokinetics, Inc.)

Various studies over the years have been conducted on the process by which plants extract materials from surrounding soils, and it has long been theorized that this activity might be used to cleanup contaminated sites. Phytoremediation uses the natural ability of plants for *in situ* remediation of contaminated soils, sediments, and water. This case study specifically describes the use of perennial ryegrass (*Lolium perenne*) in the remediation of surface soils contaminated with organic chemical wastes.

Plants enhance biodegredation partly because of root exudates (sugars, acids, alcohols, and proteins), which are released by plants into the soil. The exudates serve as a food source for soil microorganisms in the rhizosphere (the zone surrounding the plant root), causing increased microbial activity. Microorganisms in rhizosphere soils have been shown to be 10 to 100 times more active metabolically than those in unplanted soils. Exudates contain enzymes that can stimulate cometabolic transformations of contaminants by soil microorganisms. Because their fibrous root systems form a continuous dense rhizosphere, grasses are ideal for phytoremediation of surface soils. Furthermore, plants are ideal in certain remediation scenarios because they can stabilize soils against water and wind erosion.

Waste Applicability

Phytoremediation is effective when contaminant concentrations are not toxic to plants, and contaminants are present in surficial soil within the root zone of the plants (top 2 to 3 feet). Although phytoremediation is slower than most conventional technologies (such as excavation or *ex situ* treatments) and may require several growing seasons, it can prove more cost effective, especially for larger sites. Organic contaminants are shown to be more rapidly biodegraded in planted soils than unplanted soils. Contaminants to which phytoremediation is potentially applicable include polychlorinated biphenyls (PCB), chlorinated solvents, nitroaromatic explosives, insecticides, and certain polycyclic aromatic hydrocarbons (PAH).

Status

The Phytokinetics, Inc. phytoremediation technology was accepted into the ETP in 1995 for a 2-year greenhouse and field trial, with field trials beginning in 1996. Soil containing PCBs and PAHs was collected from the field study site for the greenhouse study. Results for the greenhouse experiment indicated that the presence of plants on contaminated soil increased the rate of removal of certain contaminants from the soil. Results of the greenhouse study indicated that, the concentrations of PCB and some PAHs after 2

months were significantly lower in soil with perennial ryegrass than soil without the ryegrass. In the field test, no significant difference was found in concentrations of contaminants present in planted soils and in unplanted soils. Results in the field have been affected by an uneven distribution of contaminants. Phytokinetics has not determined why the results varied between the two studies. Phytoremediation is an emerging technology that is currently in research and development.

Case Study 3: Biomineralization - Biological Immobilization of Metals (Pintail Systems, Inc.)

Ore waste containing heavy metals is present at various operating and former mining sites throughout the world. Heavy metals leached from these ores are often carried to adjacent streams and soil by storm water runoff, presenting large-scale and costly remediation problems. A binding process termed "biomineralization" that could prevent the washing away of heavy metals from waste ore was considered a potential solution.

Biomineralization is the formation and deposition of minerals mediated by living organisms. Pintail Systems, Inc. (PSI), has identified processes using active, bioaugmented organisms in soil, waste, or groundwater to form mineral groupings from dissolved or leachable metals. Dissolved metals are treated in solution using *ex situ* biological reactors, while leachable metals in soil, spent ore, and waste solids are treated *in situ* using a biosolution application.

Biomineralization occurs through the following sequence: (1) bacteria added to ore or soil attach to particle surfaces forming a "bioslime" layer; (2) soluble metals bind to cell walls and to products excreted by the microorganisms; (3) metal hydroxides, oxides, sufides, and carbonates are formed in the primary bioslime layer as mineral precursors; (4) as the mineral precursors stabablize, they provide a template for further mineralization. The biomineralization appears to follow a sequential and "layered" development on many surfaces, with outer biomineral layers tending to be more metal-enriched and mineralogically complex than inner layers.

In the short term, biominerals have been shown to be stable and resistant to leaching. Research is underway on the long-term stability of the biominerals.

Waste Applicability

The PSI biomineralization process is designed to treat solids and solutions containing heavy metals. The process has proven effective in treating spent ore, waste rock, and surface water or groundwater containing dissolved heavy metals.

Status

The PSI biomineralization technology is still in the development phase, although preliminary studies have suggested successful treatment. For example, treatment of chromic acid solutions containing about 220 ppm of chromium resulted in a 99.9 percent reduction in chromium content after a single pass through a biomineralization column system. Treatment of other metals, including cadmium, copper, iron, mercury, selenium, silver, and zinc, has resulted in reductions of over 90 percent. The PSI technology has advanced to the Demonstration Program, and a full-scale demonstration that started in FY97 will continue through FY98.

Case Study 4: Molecular Bonding System (Solucorp Industries Ltd.)

Similar to the goal of biomineralization in reducing leachability of heavy metals, the Molecular Bonding System (MBS) is a solidification/stabilization (S/S) technology developed by Solucorp Industries for the treatment of metal-contaminated soils,

sediments, sludges, and other solid wastes. MBS does not remove metal contaminants, but instead reduces leachability by chemically stabilizing the metals. The solid-phase chemical stabilization process of MBS converts heavy metal compounds, such as hydroxides, carbonates, and oxides, to less-soluble metallic sulfides without modifying the pH. The technology has been shown to reduce the leachability of arsenic, cadmium, chromium, copper, lead, mercury, and zinc contained in soils, sludges, sediments, and other solid waste.

Demonstration Results

A SITE demonstration was conducted in Midvale, Utah at the Midvale Slag Superfund sites during FY 96. The demonstration consisted of treatment of about 1,500 tons of a mixture of wastes and soils. The primary purpose of the demonstration was to determine whether the mean concentration of leachable lead was reduced to below the regulatory limit of 5 miligrams per liter (mg/L) at a 90 percent confidence interval. Data indicated that the MBS process reduced the concentration of leachable lead from an average of 29 mg/L in untreated soils and wastes to an average of 1.25 mg/L. Using MBS resulted in an increase in mean volume of the treated material by about 14 percent. The MBS process did not affect the total metals concentrations.

Costs

The applicability of the MBS process depends on the soil characteristics of the site to be remediated, and site-specific treatability tests should be conducted prior to using MBS technology. At the Midvale Slag Superfund site, treatment of soils and wastes with the MBS system cost approximately $20 per ton of waste. In contrast, the estimated cost using the alternative stabilization/solidification of lime and/or portland cement is $44 per ton.

Full-Scale Remediation

Prior to the SITE demonstration, the MBS process was successfuly used at several sites. At a pigment dye manufacturing site in Jersey City, New Jersey, a MBS system was used to reduce leachable lead concentrations from an average of 77 mg/L to a non-detectable level. Slag from a brass manufacturing plant in Waterbury, Connecticut was treated using the MBS process to reduced leachable levels of lead from 33 mg/L to nondetectable levels, and cadmium from 6 mg/L to nondetectable levels. The MBS process has also been used for full-scale cleanups at sites in West Virginia and Glasgow, Scotland.

Case Study 5: Metal-Enhanced Dechlorination (EnviroMetal Technologies, Inc)

With a movement away from typical pump-and-treat for remediation of ground water contamination, technologies that are inexpensive to implement and maintain have become a primary focus of the remediation community. Metal-enhanced dechlorination, developed by EnviroMetal Technologies (ETI) of Canada and the University of Waterloo in Canada, is a groundwater remediation technology that degrades chlorinated VOCs using an electrochemical process that oxidizes iron while chlorinated VOCs are reduced. This technology is useful for *in situ* and *ex situ* treatments, and has been shown to degrade such contaminants as halogenated methanes, ethanes and ethenes.

Two methods of metal-enhanced dechlorination are used: (1) a permeable treatment wall, or (2) a funnel and gate configuration. The permeable wall can be used aboveground in a reactor (*ex situ*) or for *in situ* treatments. For *in situ* use, a trench is excavated perpendicular to the flow of contaminated groundwater, and is then filled with the iron medium. For the funnel and gate method, water is directed to the iron wall (or gate) with a sealable slurry wall (or funnel). This method allows groundwater to be treated when it is undesirable or impossible to build an iron wall

across the entire width of the groundwater stream.

Demonstration Results

Starting in June and continuing through December 1995, an *in situ* pilot-scale demonstration of the EMT technology was conducted by the SITE Program at a confidential site in central New York. The primary objective of the demonstration was to determine whether the technology reduced the VOC concentrations to regulatory levels in the groundwater. Some of the VOC contaminants involved were vinyl chloride, trichloroethene (TCE), and cis-1,2-dichloroethene (cDCE). Results indicated that the concentrations of VOCs were significantly reduced, with removal efficiencies of over 96 percent for vinyl chloride, over 99.1 percent for TCE, and 98.6 percent for cDCE.

Costs

The cost to implement this technology is site-specific and depends on contaminant concentrations, the size of the plume to be treated, and hydrogeologic characteristics. Total costs for full-scale treatment using a continuous reactive wall are estimated to be approximately $18 per 1,000 gallons of water treated. The total cost for a full-scale treatment using a funnel and gate system is estimated at about $20 per 1,000 gallons of water treated.

Full-Scale Remediation

Metal-enhanced dechlorination was first used in December 1994 at an industrial facility in Califiornia. Since then, this technology has been selected for use on over 11 different sites with VOC contamination. Some of these sites include a U.S. Coast Guard facility in North Carolina, a semiconductor facility in San Francisco, and an industrial facility in Kansas. The SITE demonstration at the New York property resulted in a full-scale cleanup. Instead of a typical groundwater pump-and-treat system, a treatment wall measuring 300 feet wide by 15 feet deep was installed at the site at a cost of about $350,000.

Case Study 6: TechXtract Extraction Technology (EET, Inc.)

The absence of a tool for effectively removing oily liquid waste residue from concrete limits the potential use of former industrial buildings for purposes other than industrial activity. In situations where contamination is present, concrete floors are often replaced at a high cost. The TechXtract Extraction Technology (TechXtract) uses proprietary chemical mixtures (TechXtract 100, 200, and 300) to extract PCBs, heavy metals, radionuclides, or hydrocarbons from the surface or subsurface of solid materials such as floors, walls, or equipment. The TechXtract process involves two treatment cycles, and each treatment cycle consists of (1) application, (2) penetration, and (3) extraction. Application involves spraying a fine mist of one of the chemical mixtures onto the treatment surface. Penetration involves working the chemical mixture into the surface with an abrasive pad or floor scrubber. After about 45 minutes, the treatment surface is sprayed with a diluted mixture of TechXtract 300, and then extracted with a wet vacuum. The extracted treatment chemicals and contaminants are then containerized and disposed of in accordance with applicable requirements.

The treatment cycles involve varying the proprietary chemical mixtures to obtain desired results. The cycles are usually alternated and repeated as many times as necessary depending on initial contaminant concentrations and required cleanup levels. EET claims that contaminant levels at the surface can be reduced from 60 to 90 percent per treatment cycle.

Demonstration Results

The TechXtract technology was evaluated under the SITE Program during February and March 1997 at the Pearl Harbor Naval complex in Hawaii, through a partnership with Pacific Division of Naval Facilities Engineering (PACDIV) and the Pearl Harbor Public Works

Center (PWC). The evaluation site was a former air raid shelter containing a concrete floor contaminated with PCBs, a result of operation and maintenance of an electrical transformer. The TechXtract technology was applied to about 124 square feet of contaminated concrete.

The primary objectives of the SITE demonstration were to (1) determine if the technology could reduce PCB concentrations from about 5,000 micrograms per 100 square centimeters ($ug/100cm^2$), and (2) determine if the technology could extract PCBs from up to 2 inches below the concrete surface. Pre- and post-treatment wipe samples were collected for analyses to determine the PCB concentrations before and after treatment.

Wipe sample results indicated that the TechXtract technology was able to reduce surface concentrations of PCBs by greater than 99 percent. Concrete core samples did not show substantial reductions in PCBs at depth, which was likely due to subsurface PCB concentrations well above the treatability range for the technology.

Costs

The cost for using the TechXtract technology during the SITE demonstration was estimated at $39 per square foot. EET claims this estimate was high because the contaminant concentration levels were higher than the technology's claimed treatability range. Estimated costs for treating PCB-contaminated concrete within EET's treatability range are $18 per square foot for a 124-square-foot area, and about $9 per foot for a 10,000-square-foot area. Treatment costs are affected by contaminant type, size and makeup of the treatment area, the initial contaminant concentration at the surface and at depth of contamination, and cleanup goals.

Full-Scale Remediation

TechXtract has been used for over 250 field applications and can be customized for unique problems. At a DOE facility with PCB contamination over a 20,000-square-foot area, prior cleaning methods had proven unsuccessful. After applying TechXtract, the area met regulatory cleanup standards, with PCBs found nondetectable over 85 percent of the area. At a concrete area at a DOE uranium enrichment facility, uranium and technetium were present at levels as high as 14 million disintegration per minute per 100 square centimeters (dpm/100 cm^2). After treatment with TechXtract, concentrations were reduced to less that 5,000 dpm/100 cm^2. Other contracts have included the removal of hydrocarbons and solvents from concrete test cells.

FY97 Progress and Accomplishments

Demonstration Program

The objective of the Demonstration Program is to conduct field demonsrtations and high-quality performance verifications of viable remediation technologies at sites that pose high risks to human health and/or the environment, are common throughout a region or the nation, or where existing remediation methods are inadequate or too costly. The SITE Program solicits applications annually from those responsible for cleanup operations at hazardous waste sites. Respondents and these individuals have the option of suggesting one or more technologies. A panel of SITE Program scientists, engineers, and associated environmental experts reviews the applications to identify those technologies that best represent solutions for the most pressing environmental problems. The resulting data and reports are intended for use by decision-makers in selecting remediation options and for increased credibility in innovative applications.

The need for credible and reliable data for innovative technologies remains significant. For example, of the 80 RODs signed in 1994 that selected established technologies as the best alternative, 16 (or 20 percent) considered an innovative technology as an alternative for remediation of the site. The majority of the RODs indicated that innovative technologies were not chosen due to a lack of verified performance and implementability. The SITE Program serves to fill this need for credible evaluations.

During the first 10 years of the SITE Program, an emphasis was placed on innovative technologies for permanent treatment that usually required the removal of soil or groundwater. Most field demonstrations during this period in the Program's history involved *ex situ* physical/chemical and thermal technologies that could be field tested in a matter of days or weeks. The need for innovative, *in situ* technologies, that provide more cost-effective approaches to remediation will continue to increase. The SITE Program has recognized this need and has emphasized the development of *in situ* technologies. As shown in Figure 5, 64 completed SITE projects have been *ex situ* and 31 *in situ*. Of the 21 ongoing or planned demonstrations, 15 are *in situ*, while only six are *ex situ* (see Figure 5).

Field demonstration and evaluation of *in situ* technologies may require several months or years of data collection. Based on the SITE Program's increased emphasis on *in situ* technologies, the number of ongoing demonstrations will likely increase, with fewer moving from ongoing to completed status each year than in the past. It is estimated that six field demonstrations will be completed each year.

During FY97, four new innovative technologies were evaluated in the field. Due to an unusual budgetary year, the annual SITE Program solicitation was not announced in FY96. Only ongoing field projects initiated prior to FY96 were completed. Completed projects are listed in Table 1. A list of ongoing projects is provided in Table 2.

Emerging Technology Program

The SITE ETP was discontinued in 1996 due to reductions in funding to the Superfund research and development budget. The SITE program continues to honor commitments to technology developers currently in the ETP but

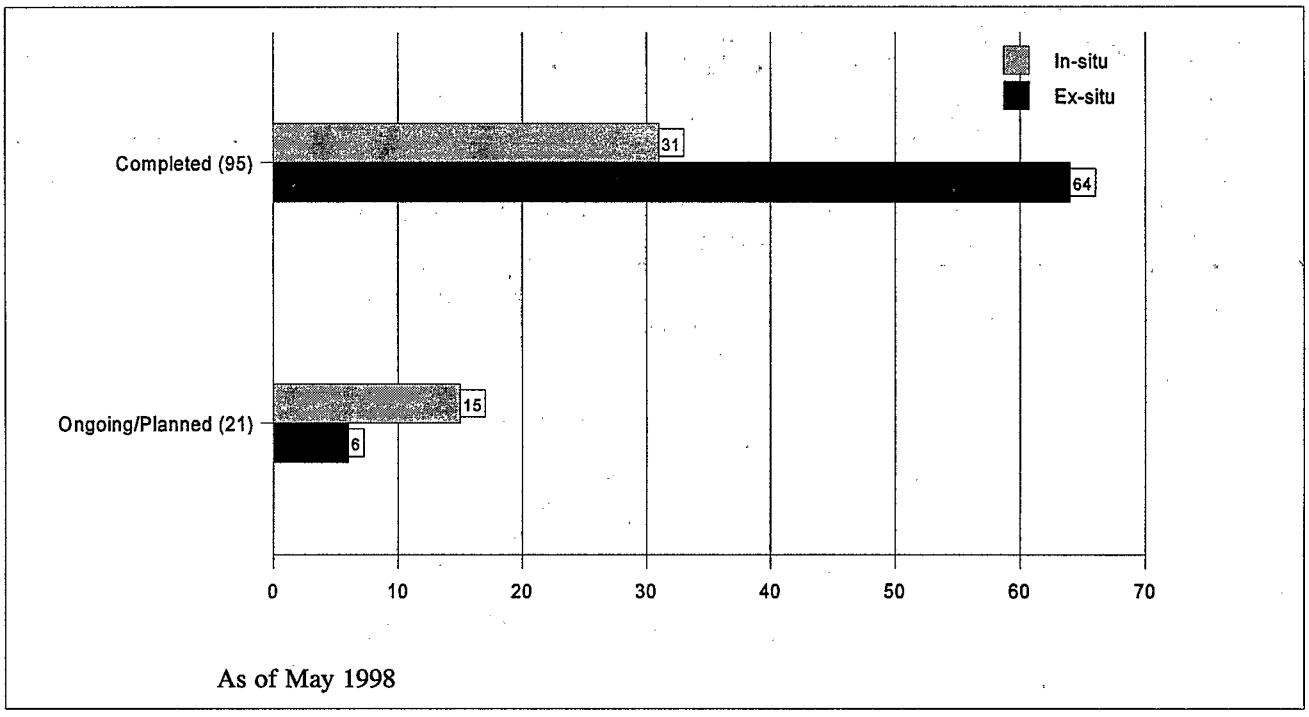


Figure 5. In-situ and ex-situ distribution of SITE demonstration projects.

no new technologies were admitted into the program after 1995. The ETP fosters the research and development of innovative technologies for remediation of Superfund and other hazardous waste sites. Technologies enter the program at the bench- or pilot-scale stage of development. EPA provides developers the opportunity to advance a technology from bench- and pilot-scale testing to demonstration.

Technologies were solicited yearly for the ETP through requests for proposals. Selected candidates were invited to submit a Cooperative Agreement application that underwent full technical review. Applications were considered for a Cooperative Agreement with a duration of up to 2 years, with funding of $150,000 per year with a $300,000 maximum. Second year funding depended on significant progress during the first year. Upon completion of the ETP, technologies were considered for the SITE Demonstration Program. Many technology vendors chose to fully commercialize their technologies after participating in the ETP.

Nine solicitations were issued from November 1987 (E01 Solicitation) to July 1995 (E09 Solicitation). A total of 77 technology development projects were initiated under the ETP, and 66 projects have been completed. Eighteen of the ETP projects are in the SITE Demonstration Program. To date, seven of the demonstration projects have been completed and 12 are ongoing. The completed emerging technology projects for FY97 are listed in Table 3.

Monitoring and Measurement Technologies Program

The MMT Program has leveraged its resources with EPA's Environmental Technology Verification (ETV) Program. These two programs, known collectively as the Consortium for Site Characterization Technologies, have developed a partnership with the DOE. Resources from the SITE Program are used solely for those technologies addressing hazardous waste. This partnership will help to address the demands on the MMT Program and reduce the backlog of applications submitted by developers of innovative technologies.

To further advance the MMT Program, a stakeholder group was formed to assist in outreach activities and in the selection of

Table 1. SITE Demonstration Projects Completed in FY 97

Developer Location	Developer	Technology	Site Location
NJ	NJIT	The Cold Top *ex situ* vitrification technology converts quantities of contaminated soil from large numbers of particles into a vitrified mass.	Newark, NJ
NY	Solucorp Industries	The Molecular Bonding System® (MBS) stabilizes heavy metal contamination in media such as soil, sludge, slag, and ash. A proprietary mixture is added to the contaminated media which converts reactive metals to insoluble, stable, nonhazardous metallic-sulfide compounds.	Midvale, UT
MO	Monsanto\ Dupont	The Lasagna process combines electroosmosis with treatment layers that are installed directly into the contaminated soil to form an integrated, in situ remedial process. The process is designed to treat soils and groundwater contaminated with VOCs. The technology was demonstrated at the DOE Paducah Gaseous Diffusion Plant.	Paducah, KY
CA	Praxis Environmental Technologies, Inc.	The in situ thermal extraction process heats soil with steam injection to enhance pump-and-treat and soil vapor extraction processes used to treat VOCs and SVOCs. Steam is introduced through injections wells and the flow sweeps contaminants to extractions wells, where they are then treated. The technology was demonstrated at Hill Air Force Base in Ogden, Utah.	Ogden, UT
CA	Terra-Kleen	A proprietary solvent blend is used in a batch process to separate hazardous constituents from soils, sediments, sludge, and debris. Solvent is cleaned for reuse through a regeneration process.	Fernald, OH
WY	Western Research Institute	The contained recovery of oily wastes (CROW®) process recovers oily waste from the ground by using steam or hot water to move waste to production wells for treatment. The demonstration was conducted at a Superfund site in Stroudsburg, PA.	Stroudsburg, PA
OH	National Risk Management Research Laboratory	The bioventing biological system treats contaminated soil in situ by injecting atmospheric air to create a continuous oxygen source for microorganisms, thus enhancing their growth. The demonstration was conducted at the Reilly Tar site on polynuclear aromatic hydrocarbon (PAH)-contaminated soils.	St. Louis Park, MN

(Continued)

Table 1. (Continued)

Developer Location	Developer	Technology	Site Location
TX	EET, Inc.	The Techxtract® process employs proprietary chemical formulations in successive steps to clean contaminated solids such as walls and floors. This technology treats polychlorinated biphenyls (PCB), hydrocarbons, heavy metals, and radionuclides in porous materials such as concrete, brick, steel, and wood.	Pearl Harbor, HI
OH	Commodore Environmental Services, Inc.	The solvated electron remediation system chemically transforms toxic contaminants such as PCBs, pesticides, and other halogenated compounds into relatively benign substances. This project is part of the Rapid Commercialization Initiative (RCI). The system was demonstrated on PCB-contaminated soils from the Naval Construction Battalion Supply Center in Port Hueneme, California.	Port Hueneme, CA

Table 2. SITE Demonstration Ongoing Projects

Developer Location	Developer	Technology	Site Location
OH	ASC\EMR Wright Patterson	Phytoremediation of groundwater involves planting deep-rooted, water-loving vegetation to reduce contaminant concentrations in the saturated zone. The U.S. Air Force has initiated a field demonstration designed to evaluate the effectiveness of eastern cottonwood trees in remediating shallow groundwater contaminated with trichloroethylene.	Ft. Worth, TX
CO	Colorado Department of Public Health and Environment	The constructed wetlands-based treatment technology uses natural geochemical and microbiological processes inherent in an artificial wetland ecosystem to accumulate and remove metals from influent waters. The demonstration will evaluate process effectiveness, toxicity reduction, and biogeochemical processes at the Burleigh Tunnel near Silver Plume, Colorado.	Silver Plume, CO
UT	Phytokinetics, Inc.	This demonstration assesses the ability of plants to reduce the concentrations of petroleum hydrocarbons in near-surface soils and the saturated zone, and to modify the groundwater gradient. The ability of alfalfa and fescue to remediate petroleum hydrocarbons in soil will be evaluated while poplar and juniper trees will be investigated for their ability to treat the saturated groundwater zone. The demonstration is currently underway at a former Chevron transfer station.	Ogden, UT

(Continued)

Table 2. (Continued)

Developer Location	Developer	Technology	Site Location
NJ	Phytotech, Inc.	The phytoremediation biotechnology uses specially selected and engineered plants to treat soil and sediment contaminated with toxic metals such as lead and cadmium, and radionuclides. The technology is currently being demonstrated at a former metal-plating facility in Findlay, OH.	Findlay, OH
CO	Pintail Systems, Inc.	This technology uses microbial detoxification of cyanide in heap leach processes to reduce cyanide levels in spent ore and process solutions. The biotreatment populations of natural soil bacteria are grown to elevated concentrations, which are applied to spent ore by drip or spray irrigation.	Battle Mountain, NV
ID	Process Technologies, Inc.	The Photolytic Destruction Technology is a method of photochemically oxidizing gaseous organic compounds within a reaction chamber. The technology uses photons of ultraviolet light to break apart chemical bonds making up VOC molecules.	Sacremento, CA
AK	Arctic Foundations Inc.	The Cryogenic Barrier creates a frozen barrier wall to contain and immobilize hazardous waste as a permanent, long-term solution. The demonstration will evaluate the barrier's ability to contain radionuclides from the Oak Ridge National Laboratory Waste Area Grouping 9 Homogenous Reactor Experiment pond.	Oak Ridge, TN
VA	ITT Industries	The Enhanced Bioremediation Technology, also called co-metabolic degradation, is designed to stimulated the naturally occurring microbial degradation of organic compounds.	Roanoke, VA

Table 3. SITE Emerging Technology Projects Completed in FY 1997

Developer Location	Developer	Technology Description	Treatment Category
AZ	Arizona State University	Integration of photocatalytic Oxidation with Air Stripping is used to treat VOCs in air produced by soil vapor extraction of contaminated soil or air stripping of contaminated groundwater. A near-ultraviolet light is used to activate a titania catalyst at or near room temperature, producing oxidizing radicals. This technology uses an oxidation reaction that destroys the VOCs and produces carbon dioxide and water. Bench-scale testing has been done and pilot-scale testing is underway.	Chemical

(Continued)

Table 3. (Continued)

Developer Location	Developer	Technology	Treatment Category
Canada	Atomic Energy of Canada Limited (AECL)	Ultrasonic-aided leachate treatment for mixed wastes is used in the treatment of acidic soil leachate solutions, or acid mine drainage. Metals and radionuclides present in the solutions are removed through precipitation, coprecipitation, oxidation, ion scavenging, sorption, and solid-liquid separation by filtration. Laboratory-scale testing of this technology is complete and AECL is currently testing a pilot-scale unit.	Physical/ Chemical
PA	Center for Hazardous Materials Research	Simultaneous destruction of organics and stabilization of metals and metal ions in soils is a technology designed to treat soils and sediments contaminated with organics and heavy metals. This process uses the reaction of organic compounds and metals with sulfur at high temperatures. The reaction converts hydrocarbons to an inert carbon-sulfur residue and metals to less-leachable sulfides. This technology has been tested on bench-scale and pilot-scale levels.	Physical/ Chemical
CA	NRT/General Atomics	The Acoustic Barrier Particulate Separator is used in the removal of particulates from gases. It produces an acoustic waveform that runs against the flow of gas at a high temperature. The waveform pushes the particulates in the opposite direction of the gas flow, causing them to collect on the wall of the separator and fall into a collection hopper. This technology is applicable in removal of gas-born solids in off-gas streams from incineration of solid and liquid media, thermal desorption, and pyrolysis. This process is currently being demonstrated on a pilot-scale level.	Physical
PA	Roy F. Weston	The Ambersorb 563 absorbent is designed to treat groundwater that is contaminated with organics. It is a regenerable adsorbent that uses a carbonaceous remediation process. It eliminates the cost of off-site disposal and regeneration that is associated with granular activated carbon (GAC). It is designed to treat any water stream that can be treated with GAC. This technology has been field tested.	Physical/ Chemical
NY	State University of New York	Electrochemical Peroxidation of PCB-Contaminated Sediments and Waters is a process applicable to liquid wastes and slurries containing low concentrations of solids. It has wide applications and can treat media containing metals and oxidizable organic compounds. In treatment, Fenton's reagent and a low direct current are used to adsorb metals and oxidize organic contaminants. This technology has been tested on a pilot-scale level.	Physical/ Chemical

(Continued)

Table 3. (Continued)

Developer Location	Developer	Technology	Treatment Category
CA	Energy and Environmental Research Corporation (EER)	The Reactor Filter System (RFS) controls the gaseous and particulate emissions that are released during thermal treatment of contaminated sludges, soils, and sediments. The RFS uses a fabric filter to control products of incomplete combustion such as toxic metals and unburned organic species. Bench-scale and pilot-scale demonstrations have been completed.	Thermal

technologies. An advocates program involving the EPA Regional offices was also established to assist in the MMT demonstration process and to ensure that the products of the demonstrations address EPA issues.

Technology Verification Process

The technology verification process is designed to generate high-quality data that can be used by EPA to verify technology performance. Four key steps are inherent in the process:

- Needs identification and technology selection
- Demonstration planning and implementation
- Report preparation
- Information distribution

Needs Identification and Technology Selection

The first aspect of the technology verification process is to determine the most important technology needs of EPA and the regulated community. EPA, the Department of Defense, DOE, industry, and state agencies are asked to identify technology needs and interest in a technology area. Once a technology need is established, a search is conducted to identify suitable technologies that will address the need. The technology search and identification process consists of reviewing responses to *Commerce Business Daily* announcements, searches of industry and trade publications, attendance at related conferences, and leads from technology developers. MMTs are evaluated against the following criteria:

- Meets regulatory or user needs
- May be used in the field or in a mobile laboratory
- Applicable to a wide variety of environmentally impacted sites
- High potential for resolving problems for which current methods are unsatisfactory
- Costs are competitive with current methods
- Performance is better than current methods in areas such as data quality, sample preparation, or analytical turnaround time
- Uses techniques that are easier and safer than current methods
- Is a commercially available, field-ready technology

Demonstration Planning and Implementation

After a technology has been selected, EPA, the support contractor, and the technology developer agree to responsibilities for conducting the demonstration and evaluating the technology. The following issues are addressed at this time:

- Identifying demonstration sites that will provide the appropriate physical or chemical attributes, in the desired environmental media
- Identifying and defining the roles of demonstration participants, observers, and reviewers
- Determining logistical and support requirements (for example, field equipment, power and water sources, mobile laboratory, or communications

network)

- Arranging analytical and sampling support
- Preparing and implementing a demonstration plan that addresses the experimental design, sampling design, quality assurance/quality control (QA/QC), health and safety considerations, scheduling of field and laboratory operations, data analysis procedures, and reporting requirements

Report Preparation

Innovative technologies are evaluated independently and, when possible, against reference technologies. The field technologies are operated by the developers in the presence of independent technology observers. The technology observers are provided by EPA or a third party group. Demonstration data are used to evaluate the capabilities, limitations, and field applications of each technology. Following the demonstration, all raw and reduced data used to evaluate each technology are compiled into a technology evaluation report, which is mandated by EPA as a record of the demonstration. A data summary and performance evaluation of each technology are published in an Environmental Technology Verification Report (ETVR).

Demonstrations in FY97

During FY97, ETVRs were completed for six field portable, X-ray fluorescence technologies demonstrated under the MMT Program in FY96. The technologies are used to evaluate the presence of, and concentrations of various heavy metals in solid wastes and soil. In FY97, demonstrations were conducted for four soil sampling technologies and two soil gas sampling technologies. Developers and their associated technologies participating in these demonstrations are shown in Table 4. The technologies were demonstrated in Albert City, Iowa and Commerce City, Colorado. Individual reports (ETVRs) have been prepared for each technology. These reports have been peer-reviewed and will be published in the third quarter of FY 98.

Ongoing Demonstrations

The MMT Program is in the first stage of identifying sediment sampling technology candidates for a demonstration to be conducted during the first quarter of FY 99. Because sediment sample collection and analysis play an important role in ecological risk assessment studies, as well as wetland protection, the science and practice of sediment sampling is of considerable interest to EPA Regional and Program Offices. This MMT project will identify and test various innovative sediment sampling devices that may prove to be more efficient or cost-effective than current technologies. The performance of each technology will be compared to commonly used, conventional procedures. The demonstration will also collect information describing the ease of operation, cost and other relevant performance characteristics of these devices. The demonstration results will assist EPA and others in the understanding and use of alternate sediment sampling technologies and will enhance the commercial development of these devices.

Planned Demonstrations

The quality of surface and finished water is an essential factor in maintaining human and environmental health. Various chemical parameters can be used to evaluate the quality of water. For example, dissolved oxygen content is often used as an indicator of the health of an aquatic environment. A number of new and portable devices have been proposed to measure various chemical indicators more accurately andinexpensively. Because of the importance of effective water quality monitoring, the MMT Program is planning a demonstration to evaluate the performance of these devices during FY99.

Table 4. SITE MMT Program Demonstrations Completed in FY97			
Developer Location	Developer	Technology	Site Location
ID	Art's Manufacturing and Supply	Dual Tube Liner Soil Sampler. This technology consists of two steel tubes of differing diameters designed so that the two tubes fit within one another. It works with direct-push sampling rigs to collect unconsolidated, subsurface soil samples.	Albert City, IA Denver, CO
IA	Clements Associates, Inc.	JMC Environmentalist's Subsoil Probe. Clements' sampler can be advanced using either manual or direct-push methods, and generates no drill cuttings.	
KS	Geoprobe Systems	Large Bore Soil Sampler. This is a single tube-type, solid barrel, closed-piston sampler. It is designed to be driven by the Geoprobe percussion probing machine to collect discrete interval soil samples, but can be used for continuous coring if desired.	
MD	Quadrel Services, Inc.	EMFLUX® Soil Gas Survey System. Quadrel's technology is a passive, near-surface investigative technology capable of identifying buried volatile and semivolatile organic compounds at concentrations in the low parts per billion range.	
CA	Simulprobe Technologies, Inc.	Core Barrel Soil Sampler. This soil sampling technology consists of a split core barrel, similar to a split-spoon sampler, a drive shoe, and a core barrel head. A drive tip seals the sample chamber until the desired depth is reached. The drive tip is then released and the sample is collected.	
MD	W.L. Gore and Associates, Inc.	GORE-SCRUBBER® Passive Soil Gas Sampler. A patented membrane system prevents soil and water from passing to sorbents, while allowing soil gas is allowed to penetrate. The sorbents are designed to minimize the affects of water vapor and to detect a broad range of volatile and semivolatile organic compounds.	

Future Direction

During FY97, the SITE Program began operating under a new approach. The SITE Program began soliciting those interested in verifying the cost and performance of innovative technologies applicable to their specific site. The approach is designed to provide those responsible for technical and financial management of hazardous waste sites with dependable, defensible data for use in the selection of remediation alternatives. Dependable, defensible data for use in the selection of remediation alternatives remains the SITE Program's foundation.

Key features to the program include the following:

- Emphasis on host site selection
- Option to evaluate one or more technologies at each site
- Quality data collection and analysis
- Cost- and performance-based information

To determine remediation community needs, SITE established a remediation stakeholder group to review applications and develop an environmental emphasis area list. The review group is comprised of individuals from DOD Environmental Security and Technology Certification Program (ESTCP), Environmental Management Program, EPA Office of Solid Waste and Emergency Response (OSWER), including Regional representation and State Agencies through the Western Governors Association (WGA)-sponsored Interstate Technology and Regulatory Workgroup (ITRC). This wide range of representation ensures that the most pressing issues are prioritized and addressed.

Site selection and technology demonstrations that meet the user community needs is essential.

Technology Areas of Primary Interest

In FY96, four priority areas for the Demonstration Program were identified: (1) organic and inorganic groundwater contamination; (2) metals in soils, sludge and sediments; (3) petroleum contamination in combination with other compounds; and (4) recalcitrant organics with low water solubility (for example PAHs, PCBs and pesticides).

Based on recommendations by the SITE Program review group, the list has been expanded considerably in FY97 (Figure 6). This list will be reviewed and updated yearly by the SITE Program remediation review group. The most significant changes are in the areas of dense nonaqueous-phase liquids (DNAPLs) in difficult geological formations, sediments, and in situ technology evaluation (for example, new material or processes, evapotranspiration covers). Many new areas for FY99 also were identified. This includes areas or media where the remediation community would benefit from new processes or less expensive methods for treatment.

As noted in the previous section, ETVRs will be generated in FY98 under the MMT Program for the six soil sampling technologies shown in Table 4. Based on concerns over contamination of river and lake sediments, FY99

Problem	1998	1999	2000	2001	2002
Groundwater					
*Organics/Inorganics	----------	----------	----------	----------	----------
*DNAPLs	----------	----------	----------	----------	----------
Fractured bedrock Karst					
*Oxygenated Compounds		----------	----------	----------	----------
Ketones Ethers Methanol MEK					
Sediments					
*Pesticides	----------	----------	----------	----------	----------
*Chlorinated Aromatics	----------	----------	----------	----------	----------
*Metals	----------	----------	----------	----------	----------
Containment					
*Alternative Caps		----------	----------	----------	----------
*Walls/Bottoms		----------	----------	----------	----------
*New Materials/Delivery Systems		----------	----------	----------	----------
In situ Technology Evaluation					
*New Materials or Processes	----------	----------	----------	----------	----------
*Evapotranspiration Covers		----------	----------	----------	----------
Groundwater/Soils					
*Chlorinated Aromatics		----------	----------	----------	----------
*Perchlorates/TNT/RDX		----------	----------	----------	----------
*Aromatics (not petroleum related)		----------	----------	----------	----------
*Creosote		----------	----------	----------	----------
*Phenols		----------	----------	----------	----------
Soils					
*Pesticides		----------	----------	----------	----------
*Metals/Pb, Hg, Cd, Cr, As, Mn	----------	----------	----------	----------	----------

Figure 6. Future SITE Environmental Emphasis Areas

will feature demonstrations of innovative technologies for sediment sampling and evaluation. The MMT Program is also considering technologies for evaluating petroleum hydrocarbon contamination in soil. To reduce costs and the amount of waste generated from monitoring remediation efforts, the long-term goals of the program will likely involve demonstrations of nonintrusive and in situ monitoring technologies, such as those involving geophysics and biosensing techniques.

Technology Field Demonstrations

Objectivity and quality data collection during the field demonstration of innovative treatment technologies remains the strength of the SITE Program. The importance of SITE Program involvement revolves around the benefits to those responsible for hazardous waste site cleanup. The data regarding innovative technologies are essential to the development of new and less expensive methods that can effectively treat hazardous media. A unique feature of the SITE Program's new approach is the solicitation for sites interested in verifying the cost and performance of cutting-edge innovative technologies that fit within identified environmental emphasis areas. This solicitation serves to (1) focus on technology needs of the user community, and (2) assist sites in cleaning up real problems. Another unique feature is that the hosting site has the option to try more than one innovative solution during the SITE demonstration.

Flexibility in matching technologies and sites remains a required service. In the first year of operation under this approach, the SITE Program selected three projects. Each of these projects is unique and addresses an environmental area identified as a priority by the SITE Program. Representatives of two of the sites have identified specific technologies for demonstration on their sites. Representatives of the third site chose to solicit and demonstrate multiple technologies. A description of demonstrations planned at the three sites is presented in Table 5.

Information Transfer

Information transfer is accomplished through a number of mechanisms. Published documentation, meetings, and conferences remain an essential part of technical information dissemination. Coordination with existing remediation workgroups and programs is also essential. The SITE Program continues to work cooperatively with the Rapid Commercialization Initiative (RCI) workgroup, DOD's ESTCP Program, DOE's Environmental Management Program, and the WGA sponsored ITRC workgroup.

Internet service allows for quick and easily accessible information, and saves time and costs in publication. The SITE Program established a homepage early in FY 97 to serve this purpose. General program information is accessible as well as quarterly reports, most recent documents, program highlights and the technology profiles of the vendors participating in the program. As a result of the SITE homepage, the number of documents printed have been reduced by 50%. The monthly average number of requests for electronic information from the SITE homepage, according to Web Server Statistics, is 400. Numerous requests come from outside the United States, reflecting an increased international interest in the SITE Program. By FY 98, all SITE documents will be loaded onto the web.

The program will continue pursuing the development of document summaries in areas where data exits on a variety of technologies or applications. This information will allow the user community to compare these technologies, along with their costs and application. One of the first will address permeable reactive barrier walls and thermal technologies. Documentation will take some time since many of the new technology are in-situ and more complex. In-situ technologies are evaluated for a minimum of 3 to 6 months. Most are evaluated for one year. In the case of phytoremediation, growing seasons span a 2-3 year period. The summaries will need updating as the technology matures and information becomes available.

Table 5. SITE Program Projects FY 98

Site Name/ Location	Technology	Project Description	Proposed Schedule
O.K. Tool Milford, NH	Surfactant Enhanced Aquifer Remediation (SEAR) Technology at Neutral Buoyancy	OK Tool manufacturing site contains VOCs in the municipal water supply well. Demonstration will evaluate technology performance for groundwater DNAPL removal in a complex subsurface geology.	Begin field demonstration Spring 1999
Crooksville and Roseville Pottery Site Crooksville, OH	Ohio EPA will solicit multiple technologies to treat shallow lead contamination in soils	Pottery production over 70 years produced lead contamination in residential areas from the use of lead-based glazing materials. Two technologies will be evaluated in situ in residential areas and one in the industrial area. The goal for the industrial area is development for reuse under EPA's Brownfields Program.	Technology selection spring 1998: begin field demonstrations summer 1998.
ITT Night Vision Roanoke, VA	Enhanced bioremediation technology by aerobic co-metabolic degradation	ITT Nightvision is an active manufacturing facility that uses chlorinated solvents in operations. Leaks from underground storage tanks contaminated groundwater in fractured bedrock over 10 years ago. The technology is designed to stimulate naturally occurring microbial degradation of chlorinated compounds.	Begin demonstration in spring 1998

http://www.epa.gov/ORD/SITE

Appendix A

SITE PROJECTS
(Alphabetically by State)

SITE PROJECTS

State	Developer	Technology	Contact	Program	Status
Alabama	CMS Research Corporation Birmingham, AL	Portable Gas Chromatograph	H. Ashley Page 205-773-6911	Monitoring and Measurement Technologies	Completed 1992
Alaska	Brice Environmental Service Corp. (BESCORP) Fairbanks, AK	Soil Washing Plant	Craig Jones 907-452-2512	Demonstration	Completed September 1992
Arizona	Arizona State University Tempe, AZ	Photocatalytic Oxidation and Air Stripping	Gregory Raupp 606-965--2828	Emerging Technology	Ongoing
	STC Omega (formerly Silicate Technology Corporation) Scottsdale, AZ	Solidification and Stabilization Treatment	Stephen Pelger or Scott Larsen 602-948-7100	Demonstration	Completed November 19990
California	Analytical and Remedial Technology, Inc. Menato Park, CA	Automated Volatile Organic Analytical System	D. MacKay 415-324-2259	Monitoring and Measurement Technologies	Completed May 1991
	Radian Corporation (formerly AWD Technologies, Inc.) Walnut Creek, CA	Integrated Vapor Extraction and Steam Vacuum Stripping	David Bluestein 510-988-1125	Demonstration	Completed September 1990
	Berkeley Environmental Restoration Center (formerly Udell Technologies, Inc.) Emeryville, CA	*In situ* Enhanced Extraction	Kent Udell 510-6442-2928	Demonstration	Completed 1993
	COGNIS, Inc. Santa Rosa, CA	Biological/ Chemical Treatment	Steve Rock U.S. EPA 513-569-7149	Emerging Technology	Completed 1995
	Energy and Environmental Research Corporation Irvine, CA	Hybrid Fluidized Bed System	Richard Koppang 714-859-8851	Emerging Technology	Completed 1992
	Energy and Research Corporation Irvine, CA	Reactor Filter System	Neil Widmer 714-859-8851	Emerging Technology	Completed 1995

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
California	Environmental Biotechnologies Montara, CA	Microbial Composting	Dougleas Munnecke 415-596-1020	Emerging Technology Demonstration	Ongoing Ongoing
	EPOC Water, Inc. Fresno, CA	Precipitation, Microfiltration, Sludge Dewatering	Rodney Squires 209-291-8144	Demonstration	Completed August 1993
	GIS\ Solutions, Inc. Concord, CA	GIS\Key Environmental Data Management Software	John Saguto 415-827-5400	Demonstration	Completed August 1993
	Groundwater Technology Government Services, Inc. Concord, CA	Biological Composting	Ronald Hicks 510-671-2387	Emerging Technology	Completed 1995
	Hughes Environmental Systems, Inc. Manhattan Beach, CA	Steam Enhanced Recovery Process	Paul De Percin U.S. EPA 513-569-7797	Demonstration	Completed September 1993
	Lockheed Martin Missiles & Space Co., Inc. Palo Alto, CA	Electrokinetic Remediation	Steven H. Schwartzkopf 415-424-3176	Demonstration	Ongoing
	Magnum Water Technology El Segundo, CA	CAV-OX Process	Dale Cox 310-640-7000	Demonstration	Completed March 1993
	Membrane Technology and Research, Inc. Menlo Park, CA	VaporSep Membrane Process	Marc Jacobs Doug Goftchlich 441-538-2228	Emerging Technology	Completed 1991
	MTI Analytical Instruments (formerly Microsensor Technology, Inc.) Fremont, CA	Portable Gas Chromatograph	David Sherve 510-490-0900	Monitoring and Measurement Technologies	Completed 1992
	NOVATERRA, Inc. (formerly Toxic Treatments USA, Inc.) Los Angeles, CA	In-situ and Air Stripping	Philip LaMori 213-969-9782	Demonstration	Completed September 1989

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
California	General Atomics (formerly Ogden Environmental Services) San Diego, CA	Circulating Bed Combuster	Jeffrey Broido 619-455-4057	Demonstration	Completed September 1989
		Acoustic Barrier Separator	Robert Goforth 619-455-4057	Emerging Technology	Completed 1995
	Praxis Environmental Services Burlingame, CA	In-situ Steam Enhanced Extraction	Lloyd Stewart 415-548-9288	Demonstration	Ongoing
	Pulse Sciences, San Leandro, CA	X-Ray Treatment (Aqueous)	Vernon Bailey 510-632-5100 ext. 227	Emerging Technology	Completed 1994
		X-Ray Treatment (Soils)	Vernon Bailey 510-632-5100	Emerging Technology	Ongoing
	Thermatrix, Inc. (Formerly Purus, Inc.) San Jose, CA	Photolytic Oxidation	Steve McAdams 408-453-0490	Emerging Technology	Completed 1992
	Retech, Inc. Ukiah, CA	Plasma Arc Vitrification	Ronald Womack and Leroy B. Leland 707-462-6522	Demonstration	Completed July 1991
	Rochem Separation Systems, Inc. Torrance, CA	Rochem Disc Tube Module System	David LaMonica 310-370-3160	Demonstration	Completed August 1994
	Roy F. Weston Woodland Hills, CA	Air Sparging Process	Jeff Bannon 818-971-4900	Demonstration	Completed 1994
	SRI Instruments Torrance, CA	Portable Gas Chromatograph	Dave Quinn 310-214-5092	Monitoring and Measurement Technologies	Completed January 1992
	SIVE Services Dixon, CA	Steam Injection and Vacuum Extraction	Douglas Dieter 916-678-8358	Demonstration	Ongoing
	U.S. Fiber (formerly Ultrox) Huntington, CA	Ultraviolet Radiation and Oxidation	William Himebaugh 714-545-5557	Demonstration	Completed march 1989
	U.S. EPA Region IX San Francisco, CA	Excavation and Foam Suppression of Volatiles	Jack Hubbard U.S. EPA 513-569-7507	Demonstration	Completed July 1990

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
California	Xon Tech, Inc. Van Nuys, CA	Xon Tech Sector Sampler	Matt Young 818-787-7380	Monitoring and Measurement Technologies	Completed 1991
	Texaco, Inc. S. El Monte, CA	Entrained-Bed Gasification	John Wintor 310-908-7387	Demonstration	Completed July 1994
	Terra-Kleen Response Group, Inc. Del Mar, CA	Solvent Extraction	Alan Cash 619-558-8762	Demonstration	(1) Completed 1994 (2) Ongoing
Colorado	Colorado School of Mines Golden, CO and Colorado Department of Health Denver, CO	Wetlands-Based Treatment	Thomas Wildeman 303-273-3642 James Lewis 303-692-3383	Emerging Technology Demonstration	Completed Ongoing
	General Environmental Corporation (formerly known as Hydrologics, Inc.) Englewood, CO	CURE Electrocoagulation	Carl Dalrymple 303-761-6960	Demonstration	Completed 1995
	Pintail Systems, Inc. Aurora, CO	Biodegradation of Cyanide	Leslie Thompson 303-367-8443	Demonstration	Ongoing
	Smith Environmental Technologies Corporation (formerly Canonie Environmental Services Corp.) Englewood, CO	Low Temperature Thermal Aeration	Joseph Hutton 303-790-1747	Demonstration	Completed September 1992
		Anaerobic Thermal Processor	Joseph Hutton 303-790-1747	Demonstration	Completed May 1991 and June 1992
	CF Systems Corporation Arvada, CO	Solvent Extraction	L.V. Benningfield 303-420-2890	Demonstration	Completed December 1988
		Batch Organics Extraction Unit	L.V. Benningfield 303-420-2890	Demonstration	Ongoing

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Colorado	Walsh Environmental Scientists and Engineers Boulder, CO	Bioslurry Reactor (technology developed by ECOVA Corp.)	William Mahaffey 303-670-2875	Demonstration	Completed September 1991
Connecticut	Dexsil Corporation Hamden, CT 4 demonstrations	Environmental Test Kits (PCB) Chlor-N-Soil L2000 PCB/Chloride Analyzer	Jack Mahon 203-288-3509	Monitoring and Measurement Technologies	Completed August 1993
Delaware	E.I. DuPont de Nemours and Co. and Oberlin Filter Co. Newark, DE and Waukesha, WI	Membrane Microfiltration	Ernest Mayer 302-774-2277	Demonstration	Completed April-May 1990
Florida	High Voltage Environmental Applications, Inc./Florida International University and University of Miami Miami, FL	High-Energy Electron Irradiation (Aqueous)	William Cooper 305-593-5330	Emerging Technology Demonstration	Completed 1993 Completed 1994
	High Voltage Environmental Applications, Inc. Miami, FL	High Energy Electronic Beam (Solids)	William Cooper 305-593-5330	Emerging Technology	Ongoing
	PCP, Inc. West Palm Beach, Fl	Ion Mobility Spectrometry	Martin Cohen 407-683-0507	Monitoring and Measurement Technologies	Completed 1991
	Funderburk and Associates Apollo Beach, FL	Dechlorination and Immobilization	Ray Funderburk 800-723-8847	Demonstration	Completed October 19987
Georgia	American Combustion, Inc. Norcross, GA	PYRETRON Thermal Destruction	Gregory Gitman 404-564-4180	Demonstration	Completed January 1988
	ETG., Inc. Norcross, GA	Long-Path Fourier Transform Infrared Spectrometer	Orman Simpson 404-242-0977	Monitoring and Measurement Technologies	Completed January 1992

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Georgia	SBP Technologies, Inc. Stone Mountain, GA	Membrane Separation and Bioremediation	Clayton Page 504-755-7711	Demonstration	Completed 1995
	Sonotech, Inc. Atlanta, GA	Frequency Tunable Pulse Combustion System	Ben Zinn 404-894-3033	Demonstration	Completed 1995
	Williams Environmental Services, Inc. (Formerly Harmon Environmental Services, Inc.) Stone Mountain, GA	Soil Washing	S. Jackson Hubbard (U.S. EPA) 513-569-7507	Emerging Technology	Exited 1992
Idaho	J.R. Simplot Co. Pocatello, ID	Anaerobic Biological Process	Russell Kaare 208-235-5620	Emerging Technology	Completed 1993
		Anaerobic Biological Process	Tom Yergovich 208-238-2850	Demonstration Dinoseb TNT	Completed July 1993 Completed February 1994
	Morrison Knudsen Corp./STG Technologies Boise, ID	Grouting Technique	Kathryn Levihn or Rick Raymondi 208-386-6115	Demonstration	Completed
	Process Technologies, Inc. Boise, ID	Photolytic Destruction of SVE offgases	Michael Swan 208-385-0900	Demonstration	Ongoing
Illinois	Institute of Gas Technology	Chemical and Biological Treatment	Robert Kelley 847-768-0722	Emerging Technology	Completed 1993
		Fluid Extraction-Biological Degradation Process	Albert Paterk 847-768-0720	Emerging Technology	Completed 1992
		Fluidized-Bed Cyclonic Agglomerating Incinerator	Mike Mensinger 847-768-0602	Emerging Technology	Completed

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Illinois	Institute of Gas Technology	Superficial Extraction/Liquid Phase Oxidation of Waste	Anil Goyal 847-768-0516 or Mike Mensinger 847-768-0510	Emerging Technology	Ongoing
	OHM Remediation Services (formerly RUST Remedial Services, Inc.) Lombard, IL	X-TRAX Thermal Desorption	Chetan Trivedi 630-261-3958	Demonstration	Completed May 1992
	Recycling Sciences, Inc. Chicago, IL	Desorption and Vapor Extraction System	William Meenan 312-663-4242	Demonstration	Ongoing
Indiana	Bio-Rem, Inc. Butler, IN	Augmented In-situ Subsurface Bioremediation Process	David Mann 219-868-5823	Demonstration	Completed December 1993
	Sevenson Environmental Services Munster, IN	MAECTITE Treatment Process	Karl Yost 219-836-0116	Demonstration	Ongoing
Kansas	Geoprobe Salina, KS	Soil, Water, Vapor Sampling Cone Penetrometer	Wes McCall 913-825-1842	Monitoring and Measuring Technologies	Completed 1995
	Trinity Environmental Technologies, Inc. Mound Valley, KS	Ultrasonically Assisted Detoxification of Hazardous Materials	Duane Koszalka 316-328-3222	Emerging Technology	Completed 1992
Louisiana	Advanced Remediation Mixing, Inc. (Formerly Chemfix Technologies, Inc.) Kenner, LA	Solidification and Stabilization	David Donaldson 504-831-3600	Demonstration	Completed March 1989
	Electrokinetics, Inc. Baton Rouge, LS	Electrokinetic Remediation	Elif Acar 504-753-8004	Emerging Technology Demonstration	Completed March 1989 Ongoing
		Electro-Klean Electrokinetic Soil Remediation	Elif Acar 504-753-8004	Emerging Technology	Ongoing

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Maine	Binax Corp., Antox Division South Portland, ME	Imunoassay for PCB in Soil	Roger Piasio 207-772-3544	Monitoring and Measurement Technologies	Completed 1992
Maryland	Microsensor System, Inc. Havre de Grace, MD	Portable Gas Chromatograph	N.L. Jarvis 410-939-1089	Monitoring and Measurement Technologies	Completed 1995
	ABB Environmental Services, Inc. Wakefield, MA	Two-Zone Plume Interception In-situ Treatment Strategy	Willard Murray 617-245-6606	Emerging Technology	Completed
Massachusetts	ABB Environmental Services, Inc. Wakefield, MA	Anaerobic/ Aerobic Sequential Bioremediation	Willard Murray 617-245-6606	Emerging Technology	Ongoing
	Bruker Instruments Billerica, MA	Bruker Mobile Environmental Monitor	John Wronka 506-667-9580	Monitoring and Measurement Technologies	Completed
	Maxymillian Technologies, Inc. (formerly Clean Berkshires) Lanesboro, MA	High Temperature Thermal Process	Jim Maxymillian 413-499-3050	Demonstration	Completed December 1993
	UV Technologies, Inc. (formerly Energy and Environmental Engineering, Inc.) East Cambridge, MA	Laser-Induced Photochemical Oxidative Destruction	James Porter 617-666-5500	Emerging Technology	Completed 1993
	HNU Systems, Inc. Newtown, MA	Portable Gas Chromatograph	Clayton Wood 617-964-6690 John Moore 617-964-6690	Monitoring and Measurement Technologies	Completed January 1992

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Massachusetts	HNU Systems, Inc. Newtown, MA	Portable X-Ray Fluorescence Spectrometer	Bob Labiberte 617-964-6690	Monitoring and Measurement Technologies	Completed 1995
	Hanby Environmental Laboratory	PCP Test Kit	John Hanby 512-847-1212	Monitoring and Measurement Technologies	Completed 1993
	KSE, Inc. Amherst, MA	Air Integrated Reaction Photocatalytic Treatment of Air	J.R. Kittrell 412-549-5506	Emerging Technology	Ongoing
	Millipore Corporation Bedford, MA	EnviroGard PCB Immunoassay Test Kit	Alan Weiss 617-275-9200	Monitoring and Measurement Technologies	Completed January 1992
		Immunoassay for PCP (Soil, Water)	Alan Weiss 617-275-9200	Monitoring and Measurement Technologies	Completed 1993
	Niton Corporation Bedford, MA	Portable X-Ray Fluorescence Spectrometer	Stephen Shefsky 617-275-9275	Monitoring and Measurement Technologies	Completed 1995
	Ohmicron Corporation Newton, MA	Immunoassay for PCP in Soil	Mary Hayes 215-860-5115	Monitoring and Measurement Technologies	Completed 1993
	PSI Technology Co. Andover, MA	Metals Immobilization and Decontamination of Aggregate Solids	Joseph Morency 508-689-0003	Emerging Technology	Completed 1993
Minnesota	BioTrol, Inc. Eden Prairie, MN	Methanotropic Bioreactor System	Durell Dobbins 612-942-8032	Emerging Technology	Completed 1992
	BioTrol, Inc. Eden Prarie, MN	Biological Aqueous Treatment System	Dennis Chilcote 612-942-8032	Demonstration	Completed July-September 1989
		Soil Washing System	Dennis Chilcote 612-942-8032	Demonstration	Completed September-October 1989
	Membrane Corporation Minneapolis, MN	Membrane Gas Transfer in Waste Remediation	Charles Gantzer 612-378-2160	Emerging Technology	Ongoing

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Montana	Montana College of Mineral Science and Technology Butte, MT	Air-Sparged Hydrocyclone	Theodore Jordan 406-496-4112	Emerging Technology	Completed 1994
	Montana College of Mineral Science and Technology Butte, MT	Campbell Centrifugal Jig	Gordon Ziesing 406-496-1573	Emerging Technology	Ongoing
Nebraska	Universiity of Nebraska Lincoln, NE	Spray Irrigation	Roy Spalding	Demonstration	Completed 1996
Nevada	U.S. EPA Las Vegas, NV	Field Analytical Screening Program (FASP)	Roy Spalding	Demonstration	Completed 1996
New Jersey	ART International, Inc. (formerly Enviro Sciences, Inc.) Denville, NJ	Low-Energy Solvent Extraction Process	Werner Steiner 201-627-7601	Emerging Technology	Completed 1994
	Dehydro-Tech. Corporation Somerville, NJ	Carver-Greenfield Process for Extraction of Oily Waste	Theodore Trowbridge 908-904-1606	Demonstration	Completed August 1991
	M.L. ENERGIA, Inc. Princeton, NJ	Reductive Photo-Dechlorination Treatment	Moshe Lavid 609-799-7970	Emerging Technology	Completed 1995
	M.L. ENERGIA, Inc. Princeton, NJ	Reductive Photo-Thermal Oxidation Processes for Chlorocarbons	Moshe Lavid 609-799-7970	Emerging Technology	Ongoing
	Hazardous Substance Management Research Center at New Jersey Institute of Technology Newark, NJ	Pneumatic Fracturing/ Bioremediation	John Schuring 201-596-5849	Emerging Technology	Completed 1994
	New Jersey Institute of Technology Newark, NJ	GHEA Associates Process	Itzhak Gottlieb 201-226-4642	Emerging Technology	Completed 1992

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
New Jersey	New Jersey Institute of Technology Newark, NJ	Cold Top Vitrification	William Librizzi 201-596-5846	Demonstration	Ongoing
	Sentex Sensing Technology, Inc. Ridgefield, NJ	Portable Gas Chromatograph	Amos Linenberg 201-945-3694	Monitoring and Measurement Technologies	Completed January 1992
New Mexico	Billings and Associates, Inc. Albuquerque, NM	Subsurface Volatilization and Ventilation System	Gale Billings 505-345-1116	Demonstration	Completed May 1994
	Resource Management and Recovery (formerly Bio-Recovery Systems, Inc.) Las Cruces, NM	AlgaSorb Biological Sorption	Mike Hosea 505-382-9228	Emerging Technology	Completed 1990
	Sandia National Laboratories Albuquerque, NM	Electrokinetic Extraction in Unsaturated Soils	Eric Lindgren 505-844-0543	Demonstration	Ongoing
New York	SBP Technologies, Inc. White Plains, NY	Bioventing, Air Sparging, Biological Treatment for Ground Water (multi-developer project with State of New York)	Richard Desrosiers 914-694-2280	Demonstration	Completed 1995
	Solucorp Industries West Nyack, NY	Molecular Bonding System	Robert Kuhn 914-623-2333	Demonstration	Ongoing
	RECRA Environmental, Inc. (formerly Electro-Pure Systems, Inc.) Amherst, NY	Alternating Current Electrocoagulation Technology	Kenneth Kinecki 800-527-3272	Emerging Technology	Completed 1992
	Photovac International, Inc. Deer Park, NY	Portable Gas Chromatograph	Mark Collins 516-254-4199	Monitoring and Measurement Technologies	Completed January 1992
	State University of New York at Oswego Oswego, NY	Photocatalytic Treatment for Sediments	Ronald Scrudato 315-341-3639	Emerging Technology	Completed 1995

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
New York	Xerox Corporation Webster, NY	Ground Water Extraction	Ron Hess 716-422-9211	Demonstration	Completed 1995
North Carolina	Ensys, Inc. Research Triangle Park, NC	Immunoassay for PCP	Stephen Friedman 914-9441-5509	Monitoring and Measurement Technologies	Completed September 1993
		Immunoassay for PCP 2 Demonstrations	Aisling Scallen 919-941-5509	Monitoring and Measurement Technologies	Completed Completed
Ohio	Battelle Memorial Institute Columbus, OH	In-situ Electroacoustic Soil Decontamination	Satya Chauhan 614-424-4812	Emerging Technology	Completed
	Ferro Corporation Independence, OH	Waste Vitrification Through Electric Melting	S.K. Muralidhar 216-641-8580	Emerging Technology	Completed
	IT Corporation Cincinnati, OH	Chelation/Electro-deposition of Toxic Metals from Soil	Radha Krishnan 513-782-4700	Emerging Technology	Ongoing
	OHM Remediation Services Corporation Findlay, OH	Oxygen Microbubble In-situ Bioremediation	Douiglas Jerger 419-424-4932	Emerging Technology	Ongoing
	University of Dayton Research Institute Dayton, OH	Photothermal Detoxification Unit (PDU)	John Graham 513-229-2846	Emerging Technology	Completed 1994
	U.S. EPA NRMRL and ETG Environmental Cincinnati, OH	Base-Catalyzed Dechlorination Process	George Huffman 513-569-7431 Yei-Shong Shieh 215-823-0700	Demonstration	Completed August 1993
	U.S. EPA Risk Reduction Engineering Laboratory and IT Corporation Cincinnati, OH	Debris Washing System	Michael Taylor or Majid Dosani 513-782-4700	Demonstration	Completed November 1992

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Ohio	U.S. EPA Risk Reduction Engineering Laboratory and FRX, Inc. Cincinnati, OH	Hydraulic Fracturing	William Slack 513-556-2526	Demonstration	Completed September 1992
Oklahoma	Geo-Microbial Technologies, Ochelata, OK	New Technology for Metals Release and Removal from Wastes	Donald Hitzman 918-535-2281	Emerging Technology	Ongoing
Oregon	Metorex, Inc. Bend, OR	Field Portable X-Ray Fluorescence (FPXRF)	Jim Pasmore 503-385-6748	Monitoring and Measuring Technologies	Completed 1995
Pennsylvania	Aluminum Company of America (formerly Alcoa Separations Technology, Inc.) Pittsburgh, PA	Bioscrubber	Paul Liu 412-826-3711	Emerging Technology	Completed 1993
	EG&G Environmental Inc. Pittsburgh, PA	NoVOCs In-Well Stripping	James Beninati 412-920-5401	Demonstration	Ongoing
	Center for Hazardous Materials Research Pittsburgh, PA	Acid Extraction Treatment System	Stephe Paff 412-826-5321	Emerging Technology	Completed 1992
		Lead Smelting	Stephe Paff 412-826-5321	Emerging Technology	Completed 1993
	Center for Hazardous Materials Research Pittsburgh, PA	Organics Destruction and Metals Stabilization	Stephe Paff 412-826-5321	Emerging Technology	Completed 1995
	Lewis Environmental Services, Inc. Pittsburgh, PA	Soil Leaching Process	Tom Lewis III 412-322-8100	Emerging Technology	Ongoing
	Ohmicron Corporation Newtown, PA	Immunoassay for PCP	Dave Hertzog 215-860-5115	Monitoring and Measurement Technologies	Completed 1993

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Pennsylvania	Calgon Carbon Oxidation Technologies (formerly Peroxidation Systems, Inc.) Pittsburgh, PA	Perox-Pur Chemical Oxidation	Bertrand Dussert 412-787-6681	Demonstration	Completed 1995
	R.E. Wright Middletown, PA	Bioventing, Air Sparging, Biological Treatment for Ground Water (multi-developer project with state of New York)	Richard Cronce 717-944-5501	Demonstration	Completed September 1992
	Geo-Con, Inc. Monroeville, PA 2 Demonstrations	In-situ Solidification/ Stabilization	Linda Ward Robert Hayden 412-856-7700	Demonstration	Completed April-May 1988
	Roy F. Weston, Inc. West Chester, PA	Low Temperature Thermal Treatment System	Mike Cosmos 215-430-7423	Demonstration	Completed December 1992
	Roy F. Weston, Inc. West Chester, PA	Steam Regeneration Adsorption System (Ambersorb)	John Thoroughgood 610-701-3728	Emerging Technology	Completed 1995
	Vortec Corp Collegeville, PA	Oxidation and Vitrification Process	James Hnat 215-489-2255	Emerging Technology Demonstration	Completed 1993 Ongoing
South Carolina	University of South Carolina Columbia, SC	In-situ Mitigation of Acid Water	Frank Caruccio 803-777-4512	Emerging Technology	Completed 1995
Tennessee	Bergmann USA Gallatin, TN	Soil and Sediment Washing Technology	George Jones 423-230-2217	Demonstration	Completed 1995
	IT Corporation Knoxville, TN	Batch Steam Distillation and Metal Extraction	Stuart Shealy 423-690-3211	Emerging Technology	Completed May 1992
		Eimco Biolift Slurry Reactor as developed by Tekno Associates	Kandi Brown 423-690-3211	Emerging Technology	Completed 1992
		Mixed Waste Treatment Process	Ed Alperin 423-690-3211	Emerging Technology	Completed 1995

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Tennessee		Photocalytic and Biological Soil Detoxificaiton	Duane Graves 615-690-3211	Emerging Technology	Completed 1993
	Brown and Root Environmental/ Illinois Institute of Technology Oak Ridge, TN	Radio Frequency Heating	Clifton Blanchard 423-483-9900 Raymond Kasevich 603-431-2266	Demonstration	Completed 1994
	WASTECH, Inc. Oak Ridge, TN	Solidification/ Stabilization	Terrence Lyons U.S. EPA 513-569-7859	Demonstration	Completed August 1991
	Thermo Nutech (formerly TMA Eberline) Oak Ridge, TN	Segmented Gate System for Radioactive Materials	Jeff Brown 423-481-0683	Emerging Technology	Ongoing
Texas	EET, Inc. Bellaire, TX	PCB/Metals Extraction from Porous Surfaces	Mike Bonem 713-662-0727	Demonstration	Ongoing
	ENSR Consulting Engineering and Larson Engineering Houston, TX	Bioventing, Air Sparging, Biological Treatment for Ground Water (multi-developer project with the State of New York)	David Ramsden (ENSR) 713-520-6802 N. Sathi-yakumar 716-272-7310	Demonstration	Completed 1995
	Filter Flow Technology, Inc. League City, TX	Heavy Metals and Radionuclide Sorption Method	Todd Johnson 281-332-3438	Demonstration	Completed September 1993
	Fugro Geosciences, Inc. Houston, TX	Laser Fluorescence PAH, BTEX Screening Cone Penetrometer	1-800-753-8476	Monitoring and Measuring Technologies	Completed 1996
	Hrubetz Environmental Services, Inc. Dallas, TX	HRUBOUT Process	Barbara Hrubetz or Michael Hrubetz 214-363-7833	Demonstration	Completed February 1993
	Solidtech, Inc. Houston, TX	Solidification and Stabilization	Jack Hubbard U.S. EPA 513-569-7507	Demonstration	Completed December 1988
	TN Spectrace Round Rock, TX	Portable X-Ray Fluorescence Spectrometer	Raj Natrajan 512-388-9200	Monitoring and Measuring Technologies	Completed 1995

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Texas	University of Houston Houston, TX	Concentrated Salt Extraction of Lead	Dennis Clifford 713-743-4266	Emerging Technology	Ongoing
	Western Product Recovery Group, Inc. Houston, TX	CCBA Physical and Chemical Treatment	Donald Kelly 713-493-9321 Bert Elkins 619-749-8856	Emerging Technology	Completed 1994
Utah	Phytokinetics, Inc. North Logan, UT	Phytoremediation of Soils	Ari Ferro 801-750-0985	Emerging Technology Demonstration	Ongoing Ongoing
Virginia	Dynaphore, Inc. Richmond, VA	Removal of Dissolved Heavy Metals via FORAGER Sponge	Norman Rainer 804-288-7109	Demonstration	Completed April 1994
	Babcock and Wilcox Co. Lynchburg, VA	Cyclone Furnace	Evan Reynolds 804-522-6000	Emerging Technology Demonstration	Completed 1992 Completed November 1991
Washington	Geosafe Corporation Richland, WA	In-situ Vitrification	James Hansen 509-375-0710	Demonstration	Completed 1994
	Remediation Technologies, Inc. (ReTec) Seattle, WA	Methanotrophic Biofilm Reactor	Hans Stroo 206-624-9349	Emerging Technology	Completed 1995
		Liquid and Soils Biological Treatment	Merv Cooper 206-624-9349	Demonstration	Completed 1996
	Ionics/ Resources Conservation Co. Bellevue, WA	BEST Solvent Extraction	William Heins 206-828-2400	Demonstration	Completed July 1992
	Scitec Corporation Richland, WA	Field Portable X-Ray Fluorescence	Steve Santy 1-800-466-5323	Monitoring and Measurement Technologies	Completed 1995
	University of Washington Seattle, WA	Asdorptive Filtration	Mark Benjamin 206-543-7645	Emerging Technology	Completed 1992
Wisconsin	Svedala Industries (formerly Allis Mineral Systems) Oak Creek, WI	Pyrokiln Thermal Encapsulation Process	Jim Kidd 414-798-6341 Glenn Heian 414-762-190	Emerging Technology	Completed 1993

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Wisconsin	University of Wisconsin, Madison, WI	Photoelectro-catalytic Treatment of Metals and Organics in Water	Marc Anderson 602-262-2674	Emerging Technology	Ongoing
Wyoming	Western Research Institute Laramie, WY	Contained Recovery of Oily Wastes (CROW)	Lyle Johnson 307-721-2281	Emerging Technology Demonstration	Completed 1991 Ongoing
Canada	Atomic Energy of Canada, Limited Chalk River, Ontario	Ultrasonic-Acid Leachate Treatment for Mixed Wastes	Shiv Vijayan 613-583-3341 ext. 3220	Emerging Technology	Completed
		Chemical Treatment and Ultrafiltration	Leo Buckley 613-584-3311	Emerging Technology	Completed 1993
	Cone Tech Investigations Vancouver, British Colombia	Resistivity, pH, Seismic, Temperature, Cone Penetrometer	Ward Phillips 604-327-4311	Monitoring and Measuring Technologies	Completed 1992
	ELI Eco Logic International, Inc. Rockwood, Ontario 2 Demonstrations	Thermal Gas Phase Reduction and Thermal Desorption Process	Jim Nash 519-856-9591	Demonstration	Completed December 1992
	EnviroMetal Technologies, Inc. Guelph, Ontario 2 Demonstrations	Metal Enhanced Abiotic Degradation	John Vogan 519-824-0432	Demonstration Ex-situ In-situ	 Completed 1995 Ongoing
	Grace Dearborn, Inc. Mississauga, Ontario	Daramend Process	Alan Seech 905-272-7480	Demonstration	Completed 1994
	Matrix Photocatalytic Limited (formerly Nutech Environmental) London, Ontario, Canada	TiO_2 Photocatalytic Treatment of Aqueous Waste Streams	Bob Henderson 519-660-8669	Emerging Technology	Completed 1994

SITE PROJECTS (continued)

State	Developer	Technology	Contact	Program	Status
Canada	Matrix Photocatalytic Limited	TiO_2 Photocatalytic Air Treatment	Bob Henderson 519-660-8669	Demonstration	Ongoing
	Toronto Harbour Comission Toronto, Ontario	Soil Recycling	Teri Richardson U.S. EPA 513-569-7949	Demonstration	Completed May 1992
	Wastewater Technology Centre Burlington, Ontario	Cross-Flow Pervaporation System	Chris Lipski 416-336-4689	Emerging Technology	Completed 1992
	Zenon Environmental Systems, Inc. Burlington, Ontario	Cross-Flow Pervaporation System	Phil Canning 905-639-6320	Demonstration	Completed 1995
		ZenoGem Process	Chris Lipski 905-639-6320	Demonstration	Completed 1995
England/United Kingdom	AEA Technology (formerly Warren Spring Laboratory) Oxfordshire, England	Physical and Chemical Treatment	Steve Barber 011-44-1235-463062	Emerging Technology	Completed 1994
	Graseby Ionics, Limited Waterford Herts, England	Ion Mobility Spectrometry	John Brokenshire 011-44-923-816166 Martin Cohen 407-683-0507	Measuring and Monitoring Technologies	Completed Summer and Fall 1990
Italy	Gruppo Italimpresse (developed by Shirco Infrared Systems, Inc.) (formerly ECOVA) Rome, Italy 2 Demonstrations	Infrared Thermal Destruction	Laurel Staley U.S. EPA 513-569-7863	Demonstration	Completed November 1987
Puerto Rico	Terra Vac, Inc. San Juan, PR	In-situ Vacuum Extraction	James Malot 787-725-8750	Demonstration	Completed April 1988

Appendix B

TECHNOLOGY DEMONSTRATION SITES
(Alphabetically by State)

TECHNOLOGY DEMONSTRATION SITES

State	Demonstration Location	Technology	Contact	Program	Status
Alaska	Fairbanks, AK ABE Superfund Site (Region 10)	Soil Washing	Brice Environmental Services Corporation (BESCORP) Fairbanks, AK Craig Jones 907-452-2515	Demonstration	Completed September 1992
Arizona	Phoenix, AZ Pesticide Site (Region 9)	Thermal Desorption	Smith Environmental Services (formerly Canonie) Porter, IN Joe Hutton 219-926-8651	Demonstration	Completed September 1992
	Phoenix, AZ Williams AFB (Region 9)	In-situ Subsurface Bioremediation	Bio-Rem Butler, IN David O. Mann 219-868-5823	Demonstration	Completed December 1993
Arkansas	Jefferson, AR Incineration Research Facility (IRF) (Region 6)	Tunable-Pulse Combustion	Sonotech, Inc. Atlanta, GA Ben Zinn 404-894-3033	Demonstration	Completed 1995
	IRF (Region 6)	Pyreton Burner (Thermal Destruction)	American Combustion Technologies Norcross, GA Gregory Gitman 404-564-4180	Demonstration	Completed January 1988
California	Burbank, CA Lockheed Site (Region 9)	Integrated In-situ Vapor Extraction and Steam Vacuum Stripping Process	Radian Corporation (formerly AWD Technologies, Inc.) Walnut Creek, CA David Bluestein 415-227-0822	Demonstration	Completed 1993
	Edwards AFB, CA	CAV-OX Oxidation Process	Magnum Water Technology El Segundo, CA Dale Cox 310-640-7000	Demonstration	Completed March 1993
	Fresno, CA Selma Site (Region 9)	Silicate Compounds by Solidification/ Stabilizatioin	STC Omega (formerly Silicate Technology Corporation) Scottsdale, AZ Steve Pegler 602-948-7100	Demonstration	Completed November 1990

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
California	Fullerton, CA McColl Superfund Site (Region 9)	Excavation and Foam Suppression of Volatiles	U.S. EPA Region 9 San Francisco, CA Jon Blevins 415-744-2400	Demonstration	Completed July 1990
	Huntington Beach, CA Rainbow Disposal (Region 9)	Steam Injection/ Vacuum Extraction (SIVE)	Hughes Environmental Manhattan Beach, CA (No longer a vendor for SIVE) Paul De Percin U.S. EPA 513-569-7797	Demonstration	Completed August 1993
	Livermore, CA Lawrence Livermore National Laboratory (LLNL) (Region 9)	Chemical Oxidation Perox-Pure	Vulcan Peroxidation Systems, Inc. Tucson, AZ Chris Giggy 602-790-8383	Demonstration	Completed 1995
	Livermore, CA LLNL (Region 9)	In-situ Enhanced Extraction	Berkley Environmental Restoration (formerly Udell Technologies, Inc.) Kent Udell 510-653-9477	Demonstration	Completed 1993
	March AFB, CA (Region 9)	In-situ Air Stripping	Roy Weston Woodland Hills, CA Jeff Bannon 818-971-4900	Demonstration	Completed 1994
	Port Hueneme, CA Naval Facilities Engineering Service Center (Region 9)	Solvated Electron Treatment of Chlorinated Organics	Commodore Environmental Columbus, OH Neil Dronby 614-297-0365	Demonstration	Completed 1996
	Sacramento, CA McClellan AFB	Groundwater Extraction	Xerox Two Phase Extraction Ron Hess 716-422-3694	Demonstration	Completed February 1995
	San Diego, CA Naval Air Station North Island (NASNI) (Region 9)	In Well Vapor Stripping of Ground Water	MACTEC Environmental, Inc. Pittsburgh, PA Mark McGlathery 303-278-5053	Project is Ongoing	Will be Completed May 1999

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
California	San Diego, CA NASNI Site 9 (Region 9)	Cross-flow Pervaporation System for Removal of VOCs from Groundwater	Zenon Environmental, Inc. Burlington, Ontario, Canada Phil Canning 905-639-6320	Demonstration	Completed 1995
	San Francisco, CA Westin Hotel (Region 9)	GIS/KEY Software for HW Site Data Management	GIS Solutions, Inc. Concord, CA Garry W. Reid 510-827-5400	Demonstration	Completed August 1993
	San Jose, CA Lorentz Barrel and Drum Site (Region 9)	Ultraviolet Ozone Treatment for Liquids	Ultrox International, Inc. Santa Ana, CA David Fletcher 562-490-4649	Demonstration	Completed May 19889
	San Pedro, CA Annex Terminal (Region 9)	In-situ Steam/ Air Stripping	Novaterra, Inc. (formerly Toxic Treatment, Inc.) Torrance, CA Phil La Mori 310-328-9433	Demonstration	Completed September 1989
	Santa Barbara, CA Santa Marie Health Care Services (UST Site) (Region 9)	Soil Washing/ Geological Treatment	BioGenesis Enterprises (formerly BioVersal USA) Fairfax Station, VA Charles Wilde 703-250-3442 Mohsen Amiran 708-827-0024	Demonstration	Completed November 1992
	South El Monte, CA (Region 9)	Gasification Process	Texaco Syngas, Inc. White Plains, NY John Winter 316-251-4000 ext. 536	Demonstration	Completed 1994
Colorado	Clear Creek, CO Burleigh Tunnel (Region 8)	Wetland-Based Treatment for Mineral Mine Drainage	Colorado Department of Health Denver, CO Jim Lewis 303-692-3390	Demonstration	Ongoing
	Denver, CO Rocky Flats (Region 8)	Colloid Polishing Method	Filter Flow Technology League City, TX Tod Johnson 713-334-6080	Demonstration	Completed November 1992

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Colorado	Denver, CO DOE Rocky Flats	Electrocoa-gulation	General Environmental Inc. (formerly Hydrologics, Inc.) Englewood, CO Carl Dalrymple 303-761-6960	Demonstration	Completed 1995
	Rocky Flats, CO	In-situ Reactive Barrier	EnviroMetal Technologies, Inc. John Vogan 519-824-0432	Demonstration	Ongoing
Florida	Brandon, FL Peak Oil Superfund Site (Region 4)	Infrared Incinerator	Grupo Italimprese (Ecova Europa) (formerly ECOVA) John Cioffi 206-883-1900	Demonstration	Completed August 1987
	Pensacola, FL American Creosote Works (Region 4)	Filtration	SBP Technologies, Inc. Baton Rouge, LA Clayton Page 504-753-5255	Demonstration	Completed 1992
	Pensacola, FL Escanbia Wood Preserving Site (Region 4)	Soil Washing	U.S. EPA Mobile Volume Reduction Unit Cincinnati, OH Richard Griffith 908-321-6629	Demonstration	Completed November 1992
Georgia	Chickamuga, GA and Hopkinsville, GA (Region 4)	Debris Washing System	U.S. EPA NRMRL Cincinnati, OH Donald Sanning 513-569-7875 Mike Taylor 512-782-4700	Demonstration	Completed August 1990
	Warner Robins, GA Robins AFB (Region 4)	Stabilization of Organics	WASTECH, Inc. Oak Ridge, TN Benjamin Peacock 615-483-6515	Demonstration	Completed August 1991
Hawaii	Pearl Harbor, HI (Region 9)	PCB/Metals Extraction from Porous Surfaces	EET Inc. Bellaire, TX Tim Tarrillion 713-662-0727	Demonstration	Ongoing

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Hawaii	Pearl Harbor, HI Naval Facility (Region 9)	Electrokinetic Flushing & Surfactant Flushing	Geokinetics and Duke Engineering Thomas Holdsworth 523-569-7675	Demonstration	Will begin in May 1998, Ongoing
Illinois	Chicago, IL (Region 4)	Hydraulic Fracturing	U.S. EPA/ NRMRL Cincinnati, OH William Slack 513-556-2526	Demonstration	Completed September 1992
	Waukegan Harbor, IL (Region 5)	Thermal Desorption	SoilTech, ATP Systems Inc. Porter, IN Joe Hutton 219-926-8651	Demonstration	Completed June 1992
	Gary, IN Indiana Harbour (Region 5)	Solvent Extraction	Ionics/Resources Conservation, Co. Bellevue, WA Bill Hines 206-828-2400	Demonstration	Completed July 1992
Kentucky	Paducah, KY Gaseous Diffustion Plant (Region 4)	In-situ Electroosmosis of TCE in Soil/ Groundwaters "Lasagna" Process	Monsanto/ Dupont Thomas Holdsworth 513-569-7675	Demonstration	Completed 1998
Louisiana	Fort Polk, LA (Region 6)	Electrokinetic Extraction	Electrokinetics, Inc. Baton Rouge, LA Elif Acar 504-388-3992	Demonstration	Ongoing
Massachusetts	New Bedford, MA (Region 1)	Solvent Extraction	CF Systems Corporation Westminister, CO L.V. Benningfield 303-420-1550	Demonstration	Completed December 1988
	North Dartsmouth, MA Resolve Superfund Site (Region 1)	Thermal Desorption	OHM Environmental (formerly Chemical Waste Management Inc.) Geneva, IL Dick Ayen 803-846-2413	Demonstration	Completed May 1992

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Michigan	Adrian, MI Anderson Development (Region 5)	Thermal Desorption (physical)	Roy F. Weston, Inc. West Chester, PA Michael Cosmos 215-430-7423	Demonstration	Completed December 1992
	Bay City, MI Bay City Municipal Landfill (Region 5)	Thermal Gas Phase Reduction Process and Thermal Desorption	ELI Eco Logic International, Inc. Rockwood, Ontario, Canada Jim Nash 519-856-9591	Demonstration	Completed December 1992
	Buchanan, MI Electro-Voice (Region 5)	Subsurface Volatilization and Ventilation System (SVVS)	Billings & Associates, Inc. Albuquerque, NM Gale Billings 505-345-1116	Demonstration	Completed May 1994
	Detroit, MI (Region 5)	Debris Washing System	U.S. EPA/ NRMRL Cincinnati, OH Donald Sanning 513-569-7444 or Mike Taylor 513-782-4700	Demonstration	Completed August 1990
	Essexville, MI Saginaw Bay Confined Disposal Facility (Region 5)	Sediment Soil Washing	Bergmann, USA Gallatin, TN Richard Traver 615-452-5500	Demonstration	Completed May 1992
	Grand Ledge, MI Parsons Chemical Site (Region 5)	In-situ Vitrification	Geosafe Corporation Richland, WA James Hansen 509-375-0710	Demonstration	Completed 1994
	Rose Township, MI (Region 5)	Infrared Incinerator	Grupo Italimprese (Ecova Europa) (formerly ECOVA) Jon Cioffi 206-883-1900	Demonstration	Completed 1987
Minnesota	McGillis & Gibbs Superfund Site, MN (Region 5)	Biotreatment of Groundwater	BioTrol, Inc. Eden Prairie, MN Dennis Chilcote 612-942-8032	Demonstration	Completed September 1989

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Minnesota	McGillis & Gibbs Superfund Site, MN (Region 5)	Soil Washing	BioTrol, Inc. Eden Prairie, MN Dennis Chilcote 612-942-8032	Demonstration	Completed October 1989
	Minneapolis, MN Private Oil Refining Company (Region 5)	Soil Washing/ Biological Treatment	BioGenesis Enterprises, Inc. (formerly BioVersal USA) Fairfax Station, VA Charles Wilde 703-250-3442 Mohsen Amiran 708-827-0024	Demonstration	Completed November 1992
	New Brighton, MN Twin Cities Army Ammunition Plant (TCAAP) (Region 5)	Removal of Lead from Soils	COGNIS TARRAMET Goss, MO Lou Magdits 573-626-3476	Demonstration	Completed 1994
	St. Louis Park, MN (Region 5)	Bioventing (air-injection)	U.S. EPA/NRMRL Cincinnati, OH Paul McCauley 513-569-7444	Demonstration	Completed Fall 1997
Mississippi	Brookhaven, MS Brookhaven Wood Preserving (Region 4)	Fungus Treatment Technology	U.S. EPA/NRMRL USDA-Forest Products Lab Madison, WI Richard Lamar 608-231-9469	Demonstration	Completed 1991
Montana	Butte, MT Butte-Silverbow Site (Region 8)	Plasma Heat	Retech, Inc. Ukiah, CA R.C. Eschenback 707-462-6522	Demonstration	Completed July 1991
	Mike Horse Mine, MT (Region 8)	Grouting Technique	Morrison Knudsen Corporation Boise, ID 208-386-6115	Demonstration	Completed 1996
	St. Louis, MT Welldon Spring (Region 7)	Anaerobic Biological Destruction of TNT in Soil	J.R. Simplot Company Pocatello, ID Dr. Kaake 208-234-5367	Demonstration	Completed February 1994

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Nebraska	Hastings, NE (Region 7)	Spray Irrigation	University of Nebraska-Lincoln Hasting, NE Roy Spalding 402-783-3931	Demonstration	Completed July 1996
Nevada	Battle Mountain, NV	Biodegradation of Cyanide	Pintain Systems, Inc. Aurora, CO Caren Caldwell 303-367-8443	Demonstration	Ongoing
New Jersey	Edison, NJ EPA (Region 2)	Solvent Extraction Carver-Greenfield Process	Dehydro Tech Corporation East Hanover, NJ Thomas Holcombe 210-887-2182	Demonstration	Completed August 1991
	Hillsborough, NJ (Region 2)	Pneumatic Fracturing, Extraction and Hot Gas Injection	Accutech, Inc. Keyport NJ & New Jersey Institute of Technology, Newark, NJ Lohn Liskowitz 908-739-6444	Demonstration	Completed August 1992
	Millville, NJ Nascoilte Site (Region 2)	Bioreactor Integrated with an Ultrafiltration Membrane System	Zenon Environmental, Inc. Burlington, Ontario, Canada Anthony Tonelli 416-639-6320	Demonstration	Completed 1995
	Morganville, NJ Imperial Oil Co., Inc. Site (Region 3)	Solidification	Solidtech, Inc. Houston, TX Bill Stallworth 713-497-8558	Demonstration	Completed December 1988
	Pedricktown, NJ National Lead Industries (Region 2)	Removal of Dissolved Metals	Dynaphore/ Forager Sponge Richmond, VA Norman Rainer 804-288-7109	Demonstration	Completed April 1994
	Trenton, NJ (Region 2)	Phytoextraction of Metal from Soil	Phytotech, Inc. Monmouth, NJ Burt Ensley 908-438-0900	Demonstration	Ongoing

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
New Jersey	Wayne, NJ (Region 2)	Ex-situ Metal-enhanced Abiotic Degredation	EnviroMetal Technologies, Inc. Guelph, Ontario John Vogan 519-824-0432	Demonstration	Completed 1995
New Mexico	Albuquerque, NM (Region 6)	Electrokenitic Extraction in Unsaturated Soils	Sandia National Laboratories, Albuquerque, NM Eric Lindgren 505-844-0543	Demonstration	Ongoing
New York	Brant, NY Wide Beach (Region 2)	Thermal Desorption Dechlorination	SoilTech, ATP Systems, Inc. Porter, IN Joe Hutton 219-926-8651	Demonstration	Completed June 1992
	Brockport, NY Sweden-3 Chapman Site (Region 2)	Biovault, Bioventing and Groundwater Circulation Biological Treatment Process	NY State Bioremediation and SBP Technologies, Inc. White Plains, NY Clayton Page 504-755-7711	Demonstration	Completed 1995
	Niagara Falls, NY (Region 2)	Cold Top Vitrification	New Jersey Institute of Technology (NJIT) Newark, NJ and Geo Tech Development Corporation, King of Prussia, PA William Librizzi 201-596-5846 or Thomas Tate 610-337-8515	Demonstration	Ongoing
	Upstate NY (Region 2)	In-situ Metal-enhanced Abiotic Degredation	EnviroMetal Technologies, Inc. Guelph, Ontario John Vogan 519-824-0432	Demonstration	Ongoing
	Utica, NY (Region 2)	High Temperature Thermal Processor	Maxymillian Technologies, Inc. (Formerly Clean Berkshires) Lanesboro, MA Jim Maxymillian 413-499-3050	Demonstration	Completed 1994

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
New York	Utica, NY Town Gas Site (Region 2)	Slurry Biodegradation	Remediation Technologies Inc. (ReTec) (formerly Mo Tec Inc.) Pitsburgh, PA David Nakles 412-380-0140	Demonstration	Completed 1991
North Carolina	Morrisville, NC Koppers Site (Region 4)	Base-Catalyzed Destruction (Dehalogenation)	U.S. EPA/ NRMRL Cincinnati, OH George Huffman 513-569-7341 Environmental Inc. Blue Bell, PA Yei-Shong Shieh 215-832-0700	Demonstration	Completed August 1993
Ohio	Aliance, OH Babcock & Wilcox Alliance Research Center (Region 5)	Cyclone Vitrification	Babcock & Wilcox Alliance Research Center Alliance, OH Lawrence King 216-829-7576	Demonstration	Completed 1991
	Cincinnati, OH EPA T&E Facility (Region 5)	Bioslurry Reactor	ECOVA Corporation Redmond, WA Alan Jones 206-883-1900	Demonstration	Completed 1991
	Dayton, OH (Region 5)	Hydraulic Fracturing	U.S. EPA/ NRMRL Cincinnati, OH William Slack 513-556-2526	Demonstration	Completed September 1992
	DOE Fernald Facility, OH (Region 5)	Solvent Extraction	Terra Kleen Corporation (name changed back from Sevenson Extraction Technology, Inc.) Alan Cash 619-552-9902	Demonstration	Completed 1997

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Oregon	Clackamas, OR Portable Equipment Co. Site (Region 10)	Chemical Fixation/ Stabilization	Advanced Remediation Mixing, Inc. (formerly Chemfix Technologies, Inc.) Metarie, LA Sam Pizzitola 504-461-0466	Demonstration	Completed March 1989
Pennsylvania	Douglassville, PA (Region 3)	Solidification/ Stabilization	Hazcon and Funderburk & Associates) Fairfield, TX Ray Funderburk 813-645-9620	Demonstration	Completed October 1987
	Palmerton, PA Palmerton Zinc Pile (Region 3)	Membrane Microfiltration	E.I. DuPont DeNemours & Company Newark, DE Oberlin Filter Company Waukesha, WI Ernest Mayer 302-366-3652	Demonstration	Completed May 1990
	Stroudsburg, PA (Region 3)	Contained Recovery of Oil Wastes	Western Research Institute Laramie, WY James Speight 307-721-2011	Demonstration	Completed August 1997
Rhode Island	Central Landfill, RI	Reverse Osmosis: Disc-Tube Module Technology	ROCHEM Separations, Inc. Torrence, CA David LaMonica 310-370-3160	Demonstration	Completed August 1994
South Carolina	Savannah River Site, SC (Region 4)	High Energy Irradiation for Destruction of Organics in Aqueous Solutions and Sludge	High Voltage Environmental Application, Inc. Florida and International University Miami, FL William Cooper 305-348-3049	Demonstration	Completed 1994
Tennessee	Oak Ridge, TN (Region 4)	Photocatalytic Aqueous Phase Organics Destruction Matrix	Matrix, Inc. London, ON Robert Henderson 519-660-8669	Demonstration	Completed 1995

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Tennessee	Oak Ridge, TN DOE Oak Ridge Facility (Region 4)	Freeze Barrier	Arctic Foundations Anchorage, AK Ed Yarmak 907-562-2741	Demonstration	Ongoing
Texas	Fort Worth, TX Carswell AFB (Region 6)	Phytoremediation of TCE in Groundwater	ASC/EMR Wright Patterson AFB Greg Harvey 513-255-7718	Demonstration	Ongoing
	San Antonio, TX Kelly AFB (Region 6)	Hot Air Injection	Hrubetz Evironmental Services, Inc. Dallas, TX Michael or Barbara Hrubetz 214-691-8545	Demonstration	Completed February 1993
	San Antonio, TX Kelly AFB (Region 6)	Radio-frequency Heating	IITRI/NUS IITRI-Chicago, IL and Haliburton/ NUS Oak Ridge, TN Clifford Blanchard 615-483-9900	Demonstration	Completed 1994
	San Antonio, TX Kelly AFB (Region 6)	Radio-frequency Heating	KAI/HNUS Oak Ridge, TN Cliff Blanchard 615-483-9900	Demonstration	Completed 1994
Utah	Hill AFB, UT (Region 8)	Steam Injection/ Vacuum Extraction	Praxis Environmental Services San Francisco, CA Dr. Lloyd Steward 415-641-9044	Demonstration	Ongoing
	Ogden, UT Chevron Transfer Facility (Region 8)	Phytoremediation of Petroleum in Soil and Groundwater	Phytokinetics, Inc. Logan, UT Ari Ferro 801-750-0985	Demonstration	Ongoing
Virginia	Roanoke, VA ITT Night Vision Facility (Region 3)	Enhanced In-situ Bioremediation of Chlorinated Compounds	ITT Industries Roanoke, VA Rosann Kryczkowski 540-362-7356	Demonstration	Ongoing

TECHNOLOGY DEMONSTRATION SITES (continued)

State	Demonstration Location	Technology	Contact	Program	Status
Washington	Ellensburg, WA (Region 10)	Anaerobic Biological Destruction of Dinoseb in Soil	J. R. Simplot Company Pocatello, ID Dr. Kaake 208-234-5367	Demonstration	Completed July 1993
Wisconsin	Sparta, WI U.S. DOD Fort McCoy (Region 5)	MAECORP Soil Stabilization	Sevenson, W.C. (formerly MAECORP) Munster, IN Karl Tost 219-836-0116	Demonstration	Ongoing
Canada	Toronto, Canada Toronto Port Industrial Division	Treatment Train for Contaminated Soils	Toronto Harbor Commissioners Toronto, Canada Dennis Lang 416-863-2047	Demonstration	Completed May 1992
	Trenton, Ontario Domtar Wood Preserving Site	Bioremediation	GRACE Bioremediation Technologies Mississauga, Ontario, Canada Alan Seech 905-272-7480	Demonstration	Completed 1994

Appendix C

PUBLICATIONS - INFORMATION TRANSFER PRODUCT DESCRIPTIONS

Documents from the
US EPA National Risk Management Research Laboratory
Land Remediation & Pollution Control Division
Measuring & Monitoring Program
General Publications

- SITE Program: Annual Report to Congress 1995 (EPA/540/R-97/508)
- SITE Profiles, Ninth Edition (EPA/540/R-97/502)
- Survey of Materials Handling Technologies Used at Hazardous Waste Sites (EPA/540/2-91/010) PB91-921283[2]
- Superfund Innovative Technology Evaluation Program: - Innovation Making a Difference (EPA/540/F-94/505)
- Superfund Innovative Technology Evaluation Program: - Technology with an Impact (EPA/540/F-93/500)
- Interim Status Report U.S. and German Bilateral Agreement on Remediation of Hazardous Waste Sites (EPA/540/R-94/500) PB94-164811[2]
- SITE Innovation on the Move (EPA/540/F-97/500)

Demonstration Project Results

Accutech Remedial Systems, Inc.--Pneumatic Fracturing Extraction and Hot Gas Injec., Phase 1
- Technology Evaluation (EPA/540/R-93/509) PB93-216596[2]
- Technology Demo. Summary (EPA/540/SR-93/509)[3]
- Demonstration Bulletin (EPA/540/MR-93/509)[3]
- Applications Analysis (EPA/540/AR-93/509) PB94-117439[2]

American Combustion, Inc. - Oxygen Enhanced Incineration
- Technology Evaluation (EPA/540/5-89/008)
- Applications Analysis (EPA/540/A5-89/008)
- Technology Demo. Summary (EPA/540/S5-89/008)[3]
- Demonstration Bulletin (EPA/540/M5-89/008)[3]

AWD Technologies, Inc. - Integrated Vapor Extraction and Steam Vacuum Stripping
- Applications Analysis (EPA/540/A5-91/002) PB92-218379[2]
- Demonstration Bulletin (EPA/540/M5-91/002)[3]

Babcock & Wilcox Co-Cyclone Furnace Vitrification
- Technology Evaluation Vol. 1 (EPA/540/R-92/017A) PB92-222215[2]
- Technology Evaluation Vol. 11 (EPA/540/R-92/017B) PB92-222223[2]
- Applications Analysis (EPA/540/AR-92/017) PB93-122315[2]
- Technology Demo. Summary (EPA/540/SR-92/017)[3]
- Demonstration Bulletin (EPA/540/MR-92/011)

Bergman USA - Soil and Sediment Washing System
- Demonstration Bulletin (EPA/540/MR-92/075)[3]
- Applications Analysis (EPA/540/AR-92/075)

Biogenesis Enterprises, Inc . - Soil and Sediment Washing Processes
- Demonstration Bulletin (EPA/540/MR-93/510)
- Innovative Tech. Eval. Report (EPA/540/R-93/510)
- SITE Technology Capsule (EPA/540/SR-93/510)

Bio-Rem, Inc. - Augmented In-Situ Subsurface Biorem Process
- Demonstration Bulletin (EPA/540/MR-93/527)[3]

BioTrol - Biological Aqueous Treatment System
- Technology Evaluation (EPA/540/5-91/001) PB92-110048[2]
- Applications Analysis (EPA/540/A5-91/001) PB91-227983[2]
- Technology Demo. Summary (EPA/540/S5-91/001)[3]
- Demonstration Bulletin (EPA/540/M5-91/001)[3]

- Soil Washing System
- Technology Evaluation Vol. 1 (EPA/540/5-91/003a) PB92-115310[2]
- Technology Evaluation Vol. 11 Part A (EPA/540/5-91/003b) PB92-115328[2]
- Technology Evaluation Vol. 11 Part B (EPA/540/5-91/003c) PB92-115336[2]
- Applications Analysis (EPA/540/A5-91/003) PB92-115245[2]
- Technology Demo. Summary (EPA/540/S5-91/003) PB92-224393[2]
- Demonstration Bulletin (EPA/540/M5-91/003)[3]

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[2] Documents with a PB number are out of stock and must be ordered by that number at cost from:
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Brice Environmental Services Corporation - Bescorp Soil Washing System Battery Enterprises Site
- Demonstration Bulletin (EPA/540/MR-93/503)[3]
- Applications Analysis (EPA/540/AR-93/503) PB95-199741[2]

Brown and Root Environmental - Subsurface Volatilization and Ventilation System
- Demonstration Bulletin (EPA/540/MR-94/529)
- Capsule (EPA/540/R-94/529a)
- Innovative Tech. Eval. Report (EPA/540/R-94/529)

Canonie Environmental Services Corporation - Low Temperature Thermal Aeration (LTTA)
- Demonstration Bulletin (EPA/540/MR-93/504)[3]
- Applications Analysis (EPA/540/AR-93/504)

CF Systems Corporation - Liquified Gas Solvent Extraction
- Technology Evaluation Vol. 1 (EPA/540/5-90/002)
- Technology Evaluation Vol. 11 (EPA/540/5-90/002a) PB90-186503[2]
- Applications Analysis (EPA/540/A5-90/002)
- Technology Demo. Summary (EPA/540/S5-90/002)

Chemfix Technologies, Inc. (Now Advanced Remediation Mixing, Inc.) - Chemical Fixation/Stabilization
- Technology Evaluation Vol. 1 (EPA/540/5-89/011a) PB91-127696[2]
- Technology Evauation Vol.11 (EPA/540/5-89/011b) PB90-274127[2]
- Applications Analysis (EPA/540/A5-89/011)
- Technology Demo. Summary (EPA/540/S5-89/011) PB91-921373[2]
- Demonstration Bulletin (EPA/540/M5-89/011)[3]

Chemical Waste Management, Inc. - X-TRAX Thermal Desorption System (Now OHM Environmental)
- Demonstration Bulletin (EPA/540/MR-93/502)[3]

Cognis, Inc. Removal of Lead from Soils
- Demonstration Bulletin (EPA/540/MR-95/535)

Dehydro-Tech Corporation - Carver - Greenfield Process
- Technology Evaluation (EPA/540/R-92/002) PB92-217462[2]
- Applications Analysis (EPA/540/AR-92/002)
- Technology Demo. Summary (EPA/540/SR-92/002)
- Demonstration Bulletin (EPA/540/MR-92/002)

Dupont/Oberlin - Membrane Microfiltration System
- Technology Evaluation (EPA/540/5-90/007) PB92-153410[2]
- Applications Analysis (EPA/540/A5-90/007) PB92-119023[2]
- Technology Demo. Summary (EPA/540/S5-90/007) PB92-22435[2]
- Demonstration Bulletin (EPA/540/M5-90/007)[3]

Dynaphore, Inc. - Forager Sponge Technology
- Demonstration Bulletin (EPA/540/MR-94/522)
- Capsule (EPA/540/R-94/522a) PB95-213229[2]
- Innovative Tech. Eval. Rept. (EPA/540/R-94/522) PB95-268041[2]

ECOVA Corporation - Bioslurry Reactor [Pilot-Scale Demonstration of Slurry-Phase Biological Reactor for Creosote-Contaminated Wastewater]
- Technology Evaluation Vol. 1 (EPA/540/5-91/009) PB93-205532[2]
- Applications Analysis (EPA/540/A5-91/009) PB94-124039[2]
- Technology Demo. Summary (EPA/540/S5-91/009)
- Demonstration Bulletin (EPA/540/M5-91/009)[3]

ELI Eco Logic International, Inc. - GasPhase Chemical Reduction
- Demonstration Bulletin (EPA/540/MR-93/522)[3]
- Technology Evaluation Vol. 1 (EPA/540/R-93/522a) PB95-100251[2]
- Technology Evaluation Appendices (EPA/540/R-93/522b) PB95-100251[2]
- Applications Analysis (EPA/540/AR-93/522)
- Technology Demo. Summary (EPA/540/SR-93/522)

- Thermal Desorption Unit
- Demonstration Bulletin (EPA/540/MR-94/504)[3]
- Applications Analysis (EPA/540/AR-94/504)

EnviroMetal Technologies, Inc . - Metal-Enhanced Abiotic Degradation Technology
- Demonstration Bulletin (EPA/540/MR-95/510)[3]
- Capsule (EPA/540/R-96/503a)
- Innovative Tech. Eval. Rept. (EPA/540/R-96/503)

EPOC Water, Inc. - Microfiltration Technology
- Demonstration Bulletin (EPA/540/MR-93/513)[3]
- Applications Analysis (EPA/540/AR-93/513)

Filter Flow Technology, Inc. - Colloid Polishing Filter Method
- Demonstration Bulletin (EPA/540/MR-94/501)
- Capsule (EPA/540/R-94/501a) PB95-122792[2]
- Innovative Tech. Eval. Rept. (EPA/540/R-94/501)

GeoTech Development Corporation - Cold Top Vitrification
- Demonstration Bulletin (EPA/540/MR-97/506)

Geosafe Corporation - In-Situ Vitrification
- Demonstration Bulletin (EPA/540/MR-94/520)[3]
- Capsule (EPA/540/R-94/520a) PB95-177101[2]
- Innovative Tech. Eval. Rept. (EPA/540/R-94/520)

GIS/Solutions, Inc. - GIS/KEY Environmental Data Management System
- Demonstration Bulletin (EPA/540/MR-94/505)[3]

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- Capsule (EPA/540/SR-94/505)[3]
- Innovative Tech. Eval. Rept. (EPA/540/R-94/505) PB95-138319[2]

Grace Dearborn Bioremediation Technology
- Demonstration Bulletin (EPA/540/MR-95/536)
- Capsule (EPA/540/R-95/536a)
- Innovative Tech. Eval. Rept. (EPA/540/R-95/536)

Gruppa Italimpresse (developed by Shirco Infrared Systems, Inc.) - Infrared Incineration
- Technology Evaluation - Peake Oil Vol. 1 (EPA/540/5-88/002a) PB89-125991[2]
- Technology Evaluation Report - Peake Oil Vol. 11 (EPA/540/5-88/002b) PB89-116024[2]
- Technology Evaluation - Rose Township (EPA/540/5-89/007a) PB89-167902[2]
- Technology Evaluation- Rose Township Vol. 11 (EPA/540/5-89/007b) PB89-167910[2]
- Applications Analysis (EPA/540/A5-89/010) PB89-233423[2]
- Technology Demo Summary (EPA/540/S5-89/007)[3]
- Demonstration Bulletin (EPA/540/M5-88/002)[3]

Hazcon, Inc. (now Funderburk and Assoc.) - Solidification Process
- Technology Evaluation Vol. 1 (EPA/540/5-89/001a) PB89-158810[2]
- Technology Evaluation Vol. 11 (EPA/540/5-89/001b) PB89-158828[2]
- Applications Analysis (EPA/540/A5-89/001) PB89-206031[2]
- Technology Demo Summary (EPA/540/S5-89/001)[3]
- Demonstration Bulletin (EPA/540/M5-89/001)[3]

High Voltage Environmental Applications, Inc.
- Demonstration Bulletin (EPA/540/MR-96/504)
- Innovative Tech. Eval. Rept. (EPA/540/R-96/504)

Horsehead Resource Development Co., Inc. - Flame Reactor
- Technology Evaluation Vol. 1 (EPA/540/5-91/005) PB92-205855[2]
- Applications Analysis (EPA/540/A5-91/005) PB92-213214[2]
- Technology Demo Summary (EPA/540/S5-91/005)
- Demonstration Bulletin (EPA/540/M5-91/005)

Hrubetz Environmental Services, Inc. - HRUBOUT Process
- Demonstration Bulletin (EPA/540/MR-93/524)[3]

Hughes Environmental Systems, Inc. - Steam Enhanced Recovery Process
- Demonstration Bulletin (EPA/540/MR-94/510)[3]
- Capsule (EPA/540/R-94/510a)
- Innovative Tech. Eval. Rept. (EPA/540/R-94/510)

IT Research Institute (Brown and Root Environmental, Inc.) - Radio Frequency Heating
- Demonstration Bulletin (EPA/540/MR-94/527)
- Capsule (EPA/540/R-94/527a)
- Innovative Tech. Eval. Rept. (EPA/540/R-94/527)

International Waste Technologies/Geo-Con, Inc . - In-Situ Solidification and Stabilization Process
- Technology Evaluation Vol. 1 (EPA/540/5-89/004a) PB90-194161[2]
- Technology Evaluation Appendices (EPA/540/R-93/522b) PB95-100251[2]
- Technology Evaluation Vol. 11 (EPA/540/5-89/004b) PB89-194179[2]
- Technology Evaluation Vol. 111 (EPA/540/5-89/004c) PB90-269069[2]
- Technology Evaluation Vol. 1V (EPA/540/5-89/004d) PB90-269077[2]
- Applications Analysis (EPA/540/A5-89/004) PB90-269085[2]
- Technology Demo. Summary (EPA/540/S5-89/004)[3]
- Technology Demo. Summary, Update Report (EPA/540/S5-89/004a)[3]
- Demonstration Bulletin (EPA/540/M5-89/004)[3]

KAI Technologies Inc./Brown and Root Environmental Radio Frequency Heating
- Demonstration Bulletin (EPA/540/MR-94/528)
- Capsule (EPA/540/R-94/528a)
- Innovative Tech. Eval. Report (EPA/540/R-94/528)

Magnum Water Technology - CAV-OX Ultraviolet Oxidation Process
- Demonstration Bulletin (EPA/540/MR-93/520)[3]
- Applications Analysis (EPA/540/AR-93/520) PB94-189438[2]
- Technology Evaluation (EPA/540/R-93/520) PB95-166161[2]
- Technology Demo Summary (EPA/540/SR-93/520)[3]

Matrix Photocatalytic Ltd. - Photocatalytic Aqueous Phase Organics Destruction Process
- Innovative Tech. Eval. Report (EPA/540/R-97/503)

Maxymillian Technologies (formerly Clean Berkshires, Inc.) - Thermal Desorption System
- Demonstration Bulletin (EPA/540/MR-94/507)
- Capsule (EPA/540/R-94/507a) PB95-122800[2]

New Jersey Institute of Technology - Cold Top Vitrification Process
- Demonstration Bulletin (EPA/540/MR-97/506)

New York State Multi-Vendor Bioremediation: - ENSR Consulting & Engineering/Larson Engineers - Ex-Situ Biovault
- Demonstration Bulletin (EPA/540/MR-95/524)

- R.E. Wright Environmental Inc. - In-Situ Bioremediation System
- Demonstration Bulletin (EPA/540/MR-95/525)

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North American Technologies Group, Inc. - SFC Oleofiltration System
- Demonstration Bulletin (EPA/540/MR-94/525)
- Capsule (EPA/540/R-94/525a) PB95-167227[2]
- Innovative Tech. Eval. Rept. (EPA/540/R-94/525)

Ogden Environmental Services, Inc. (now General Atomics) - Ogden Circulating Bed Combustor
- Demonstration Bulletin (EPA/540/MR-92/001)[3]
- Technology Evaluation (EPA/540/R-92/001) PB92-227289[2]

Peroxidation Systems, Inc. (now Calgon Carbon Oxidation Technologies) - Perox-Pure™ Chemical Oxidation
- Demonstration Bulletin (EPA/540/MR-93/501)[3]
- Applications Analysis (EPA/540/AR-93/501) PB94-130325[2]
- Technology Evaluation (EPA/540/R-93/501) PB93-213528[2]
- Technology Demo Summary (EPA/540/SR-93/501)[3]

Resources Conservation Company - The Basic Extractive Sludge Treatment (B.E.S.T.) - Solvent Extraction
- Demonstration Bulletin (EPA/540/MR-92/079)[3]
- Applications Analysis (EPA/540/AR-92/079)
- Technology Evaluation -Vol. 1 (EPA/540/R-92/079a) PB93-227122[2]
- Technology Evaluation Vol. 11, Part 1 (EPA/540/R-92/079b) PB93-227130[2]
- Technology Evaluation Vol. 11, Part 2 (EPA/540/R-92/079c) PB93-227148[2]
- Technology Evaluation Vol. 11, Part 3 (EPA/540/R-92/079d) PB93-227155[2]
- Technology Demo Summary (EPA/540/SR-92/079)

Retech, Inc. - Plasma Centrifugal Furnace (Plasma Arc Vitrification)
- Demonstration Bulletin (EPA/540/M5-91/007)
- Technology Evaluation -Vol. 1 (EPA/540/5-91/007a) PB92-216035[2]
- Technology Evaluation Vol. 11 (EPA/540/5-91/007b) PB92-216043[2]
- Applications Analysis (EPA/540/A5-91/007) PB92-218791[2]
- Technology Demo Summary (EPA/540/S5-91/007)

Risk Reduction Engineering Laboratory - and IT Corporation - Debris Washing System
- Technology Evaluation -Vol. 1 (EPA/540/5-91/006a) PB91-231456[2]
- Technology Evaluation Vol. 11 (EPA/540/5-91/006b) PB91-231464[2]
- Technology Demo Summary (EPA/540/S5-91/006)[3]

- and University of Cincinnati-Hydraulic Fracturing of Contaminated Soil
- Demonstration Bulletin (EPA/540/MR-93/505)[3]
- Technology Evaluation and Applications Analysis Combined (EPA/540/R-93/505) PB94-100161[2]
- Technology Demo Summary (EPA/540/SR-93/505)[3]

-and USDA-Forest Products Technology - Fungal Treatment Technology
- Demonstration Bulletin (EPA/540/MR-93/514)[3]

-Mobile Volume Reduction Unit at the Sand Creek Superfund Site
- Treatability Study Bulletin (EPA/540/MR-93/512)[3]

-Mobile Volume Reduction Unit at the Escambia Superfund Site
- Treatability Study Bulletin (EPA/540/MR-93/511)[3]

-Volume Reduction Unit
- Demonstration Bulletin (EPA/540/MR-93/508)
- Applications Analysis (EPA/540/AR-93/508)
- Technology Evaluation (EPA/540/R-93/508)[3] PB94-136264[2]
- Technology Demo Summary (EPA/540/SR-93/508)

Roy F. Weston, Inc.
-and IEG Technologies-Unterdruck-Verdampfer-Brunner Technology (UVB) Vacuum Vaporizing Well
- Demonstration Bulletin (EPA/540/MR-95/500)
- Capsule (EPA/540/R-95/500a)

- Low Temperature Thermal Treatment (LT3) System
- Demonstration Bulletin (EPA/540/MR-92/019)[3]
- Applications Analysis (EPA/540/AR-92/019)

SBP Technologies, Inc. - Membrane Filtration and Bioremediation
- Demonstration Bulletin (EPA/540/MR-92/014)[3]
- Applications Analysis (EPA/540/AR-92/014)

Silicate Technology Corporation (Now STC Omega) - Solidification/Stabilization of Organic/Inorganic Contaminants
- Demonstration Bulletin (EPA/540/MR-92/010)[3]
- Applications Analysis (EPA/540/AR-92/010) PB93-172948[2]
- Technology Evaluation (EPA/540/R-92/010) PB95-255709[2]
- Technology Demo Summary (EPA/540/SR-92/010)[3]

Simplot, J.R. - Ex Situ Anaerobic Bioremediation Technology: TNT
- Demonstration Bulletin (EPA/540/MR-95/529)
- Capsule (EPA/540/R-95/529a)
- Innovative Tech. Eval. Report (EPA/540/R-95/529)

Simplot, J.R. - Ex-Situ Anaerobic Bioremediation System (The SABRE Process)
- Demonstration Bulletin (EPA/540/MR-94/508)
- Capsule (EPA/540/R-94/508a)
- Innovative Tech. Eval. Report (EPA/540/R-94/508)

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Soiltech ATP Systems, Inc.
-Aostra-SoilTech Anaerobic Thermal Process
- Demonstration Bulletin (EPA/540/MR-92/008)

-SoilTech Anaerobic Thermal Processor
- Demonstration Bulletin (EPA/540/MR-92/078)[3]

Soliditech, Inc. - Solidification and Stabilization
- Technology Evaluation -Vol. 1 (EPA/540/5-89/005a) PB90-191750[2]
- Technology Evaluation Vol. 11 (EPA/540/5-89/005b) PB90-191768[2]
- Applications Analysis (EPA/540/A5-89/005) PB91-129817[2]
- Technology Demo Summary (EPA/540/S5-89/005)[3]
- Demonstration Bulletin (EPA/540/M5-89/005)[3]

Solucorp - Molecular Bonding System
- Innovative Tech. Eval. Report (EPA/540/R-97/507)

Sonotech, Inc. - Cello Pulse Combustion Burner System
- Demonstration Bulletin (EPA/540/MR-95/502)[3]
- Capsule (EPA/540/R-95/502a)
- Innovative Tech. Eval. Report (EPA/540/R-95/502)

TerraKleen Response Group, Inc. - Solvent Extraction Treatment System
- Demonstration Bulletin (EPA/540/MR-94/521)[3]
- Capsule (EPA/540/R-94/521a) PB95-213617[2]

Terra Vac, Inc. - In Situ Vacuum Extraction
- Demonstration Bulletin (EPA/540/M5-89/003)[3]
- Technology Evaluation -Vol. 1 (EPA/540/5-89/003a) PB89-192025[2]
- Technology Evaluation Vol. 11 (EPA/540/5-89/003b) PB89-192033[2]
- Applications Analysis (EPA/540/A5-89/003)
- Technology Demo Summary (EPA/540/S5-89/003)[3]

Texaco, Inc. - Entrained-Bed Gasification Process
- Demonstration Bulletin (EPA/540/MR-94/514)
- Capsule (EPA/540/R-94/514a)
- Innovative Tech. Eval. Report (EPA/540/R-94/514)

Thorneco, Inc. - Enzyme - Activated Cellulose Technology
- Treatability Study Bulletin (EPA/540/MR-92/018)[3]

Toronto Harbour Commission - Soil Recycling Treatment Train
- Demonstration Bulletin (EPA/540/MR-92/015)
- Applications Analysis (EPA/540/AR-93/517)
- Technology Evaluation (EPA/540/R-93/517) PB93-216067[2]
- Technology Demo Summary (EPA/540/SR-93/517)

Toxic Treatments USA, Inc. (Now NOVATERRA, Inc.) - In-Situ Steam/Hot Air Stripping
- Demonstration Bulletin (EPA/540/M5-90/003)
- Applications Analysis (EPA/540/A5-90/008)

Ultrox, a Division of Zimpro Environmental, Inc. - UV Ozone Treatment for Liquids
- Demonstration Bulletin (EPA/540/M5-89/012)[3]
- Applications Analysis (EPA/540/A5-89/012) PB91-129759[2]
- Technology Evaluation (EPA/540/5-89/012) PB90-198177[2]
- Technology Demo Summary (EPA/540/S5-89/012)[3]

U.S. EPA - McColl Superfund Site - Demonstration of a Trial Excavation
- Technology Evaluation (EPA/540/R-92/015) PB92-226448[22]
- Applications Analysis (EPA/540/AR-92/015) PB93-100121[2]
- Technology Demo Summary (EPA/540/SR-92/015)

Wheelabrator Clean Air Systems, Inc. (formerly Chemical Waste Management, Inc.) - PO*WW*ER™ Technology
- Demonstration Bulletin (EPA/540/MR-93/506)[3]
- Applications Analysis (EPA/540/AR-93/506)
- Technology Evaluation -Vol. 1 (EPA/540/R-93/506a) PB94-160637[2]
- Technology Evaluation Vol. 11(EPA/540/R-93/506b) PB94-160660[2]
- Technology Demo Summary (EPA/540/SR-93/506)

Zenon Environmental, Inc. - Zenon Cross-FlowPervaporation Technology
- Demonstration Bulletin (EPA/540/MR-95/511)
- Capsule (EPA/540/R-95/511a)

Zenon Environmental Systems - Zenogem Wastewater Treatment Process
- Demonstration Bulletin (EPA/540/MR-95/503)[3]
- Capsule (EPA/540/R-95/503a)[3]

[1] Order documents free of charge by calling EPA's Center for Environmental Research Information (CERI) at 513-569-7562 or Fax 513-569-8695.
[2] Documents with a PB number are out of stock and must be ordered by that number at cost from:
National Technical Information Service
5285 Port Royal Road
Springfield VA 22161
Telephone 703-487-4650 or 1-800-553-6847
[3] Out of stock

Appendix D

ELECTRONIC TECHNICAL INFORMATION RESOURCES

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EPA Sources of Information on Innovative Remediation and Site Characterization Technologies

Listed below are U.S. Environmental Protection Agency (EPA) sources of information on Innovative Remediation and Site Characterization Technologies. Sources of information include: electronic information sources in the form of databases or Internet sites, as well as programs, partnerships and organizations accessible on the Internet.

REMEDIATION TECHNOLOGIES

Electronic Information Sources

Alternative Treatment Technology Information Center (ATTIC). The Alternative Treatment Technology Information Center (ATTIC) is a comprehensive computer database system that provides up-to-date information about innovative treatment technologies. The database contains information about biological, chemical, and physical treatment processes; solidification and stabilization processes; and thermal treatment technologies. The on-line automated bibliographic reference integrates existing data on hazardous waste into a unified searchable resource. The ATTIC system provides users with access to several independent databases, an electronic bulletin board system, a hotline, and a repository of publications related to alternative and innovative treatment technologies. The ATTIC database can be access through the Internet at ***<http://www.epa.gov/attic>*** or by modem at (703) 908-2138. Assistance can be reached by telephone at (703) 908-2137.

Bioremediation in the Field Search System (BFSS) Version 2.1. BFSS is a PC-based searchable database of information about sites at which bioremediation is being tested or implemented or at which cleanup by bioremediation has been completed. The database covers sites being addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), as well as those being addressed under the Underground Storage Tank (UST) Program. Information is available about location, media, contaminants, technology, cost and performance. BFSS can be downloaded free of charge from the ATTIC or the Hazardous Waste Clean-Up Information (CLU-IN) Internet sites at ***<http://www.epa.gov/attic>*** or ***<clu-in.com>***.

Completed North American Innovative Remediation Technology Demonstration Projects Database. The searchable database contains information about more than 300 completed innovative technology field demonstration projects in North America. The purpose of the database is to consolidate key information from innovative demonstration projects into a single source and present that information in a format that enables the user to easily identify innovative technologies that may be appropriate to the user's particular site remediation needs. The database, which is limited to completed demonstration projects and a small number of full-scale cleanup efforts, does not include emerging technologies or laboratory-scale projects. The database can be downloaded free of charge from the CLU-IN Internet site at ***<http://clu-in.com>***.

Hazardous Waste Clean-Up Information (CLU-IN) Home Page. CLU-IN is a streamlined source of information about innovative remediation and site characterization technologies for hazardous waste cleanup professionals. It provides access to information about programs, organizations, publications, and other tools for EPA and other Federal and State personnel, consulting engineers, technology developers and venders, remediation contractors, researchers, community groups, and individual citizens. Access to various tools of information is presented in the form of downloadable publications and databases. Sources of additional information on the Internet also are presented through a series of links. CLU-IN is sponsored by EPA's Technology Innovation Office (TIO). For additional information about the CLU-IN home page, call (301) 589-8368. CLU-IN can be accessed through the Internet at ***<http://clu-in.com>***.

Innovative Treatment Technologies: Annual Status Report (Eighth Edition) and ITT Database, Version 2.0. The ITT 2.0 is a Windows ™-based searchable database that contains data on nearly 400 contaminated sites documented in the eighth addition of the Annual Status Report. The database also contains information about remedies selected at contaminated waste sites listed in the *Innovative Treatment Technologies: Annual Status Report (ASR), Eighth Edition* (EPA-542-R-96-010). The sites include Superfund remedial and removal sites and some non-Superfund sites being remediated by the U.S. Department of Energy (DOE), the U.S. Department of Defense (DoD), or under the RCRA corrective action

program. The ITT database includes such site-specific data as contaminants and media treated, project status, and site contact. It also contains most of the text and graphics in the report, except appendices A, B, C, D, E, and F of that report. The database also includes detailed information about sites being remediated by the application of innovative soil and groundwater technologies, such as thermal desorption, soil vapor extraction, soil washing, and air sparging. If you have questions or comments about the system, please call EPA's TIO at (703) 603-9910. The database can be downloaded free of charge from the CLU-IN Internet site at ***<http://clu-in.com>***. To obtain a copy of the report, call EPA's National Center for Environmental Publications and Information (NCEPI) at (800) 490-9198 or (513) 489-8190. Note that the database contains most of the information that appears in the report.

Remediation Technologies Screening Matrix and Reference Guide, Version 3.0. The Remediation Technologies Screening Matrix and Reference Guide, Version 3.0, prepared for federal agencies participating on the Federal Remediation Technology Roundtable (FRTR), provides a "yellow pages" of remediation technologies information. The guide is intended to assist remedial project managers (RPM) to screen and evaluate candidate cleanup technologies and select the best remedial alternatives(s) for contaminated installations, facilities, or waste sites. The guide also assists environmental professionals in gathering essential descriptive information on the respective technologies. The guide incorporates cost and performance data to the maximum extent available and focuses primarily on demonstrated technologies. However, information on emerging technologies also is included in the guide. The guide can be accessed through the Internet at ***<http://www.frtr.gov>***.

TechDirect. TechDirect, hosted by EPA's TIO, is an information service that highlights new publications and events of interest to environmental professionals. Information about site characterization and remediation technologies are available through this Internet subscription service. Approximately once a month, the service distributes by electronic mail, a message describing the availability of publications and announcements of events. For publications, the message explains how to obtain a hard copy or how to download an electronic version from the Internet. For additional information about TechDirect, contact Jeff Heimermann at (703) 603-7191 or by E-mail at *heimerman.jeff@epamail.epa.gov*. TechDirect can be accessed through the Internet at ***<http://clu-in.com/membersh.htm>***.

Vendor Information System for Innovative Treatment Technologies (VISITT), Version 6.0 (EPA 542-C-98-001). VISITT 6.0 is a Windows ™-based system that contains information about 371 innovative remediation technologies (70 percent of which are commercially available) offered by 214 vendors. The major technology categories are acid and solvent extraction; bioremediation; chemical treatment, *in situ* thermally enhanced recovery; soil vapor extraction; soil washing; thermal desorption; and vitrification. VISITT 6.0 provides detailed information that enables users to screen and assess remediation technologies quickly. Users also can build queries that reflect the conditions at a particular site. The system is available on compact disk and requires a minimum of a 486 IBM-compatible computer running MS Windows 3.1 or MS Windows 95, 8 MB RAM, and 21 MB of free disk space. The database also can be downloaded free of charge from the CLU-IN Internet site at ***<http://clu-in.com>***.

Programs, Partnerships, And Organizations

Bioremediation Action Committee (BAC). EPA's Office of Research and Development (ORD) and Office of Solid Waste and Emergency Response (OSWER) co-chair the BAD. The BAD is dedicated to the development of bioremediation technologies and focuses on research in the areas of bioventing, cometabolic processes, *in situ* groundwater remediation, and natural attenuation. The BAD strives to 1) identify priority needs for the development of bioremediation technology; 2) establish and oversee subcommittees to plan and implement collaborative research projects to address bioremediation issues; 3) address scientific, institutional, and regulatory barriers to bioremediation technologies; and 4) coordinate activities among various organizations. For more information about the BAD, please contact Walter W. Kovalick, Jr., Ph.D. of EPA's TIO at (703) 603-9910 or Lee Mulkey of EPA's National Risk Management Research Laboratory (NRMRL) at (513) 569-7689. BAD is accessible on the Internet at ***<http://clu-in.com/bac.htm>***.

EPA and Clean Sites, Inc. Public-Private Partnership. Under the partnership, the owner of the federal facility and one or more private companies (that are responsible for cleanup of site having the same type of contamination problems as the federal facility) would form a group to guide the design, construction, and evaluation of full-scale innovative technologies or treatment trains at a federal facility such as the Navy's North Island Facility. Membership in the group also would be open to representatives of EPA, state regulatory agencies, and interested community groups. The overall goal of the proposed a partnership would be to collect and transfer meaningful information about

the cost and performance of innovative technologies and treatment trains that are tested under real-world, full-scale conditions, while at the same time fitting into the federal facility's existing restoration program. The joint technology evaluation program, therefore, is aimed specifically at innovative technologies that already have been demonstrated at either the pilot or full scale, but that have not yet been used widely for remedial actions. For more information about the partnership, contact Daniel Powell of EPA's TIO at (703) 603-9135. Additional Information about the partnership can be accessed through the Internet at ***<http://clu-in.com/clnsites.htm>***.

EPA Library Network Program. The EPA National Library Network Program is a repository of information from EPA's Headquarters, Regional and Field Offices, Research Centers, and specialized laboratories throughout the country. The Library Network provides access to its collection through the On-line Library System (OLS), a menu-driven database of the library's holdings. The OLS provides users with the ability to perform online searches by author, title, or keyword. The EPA National Library Network Program can be accessed through the Internet at ***<http://www.epa.gov/natlibra>***.

Federal Remediation Technologies Roundtable (FRTR). FRTR is an interagency working group that provides a forum for the exchange of information regarding the development and demonstration of innovative technologies for the remediation of hazardous waste sites. The forum also synthesizes the technical knowledge that Federal Agencies have compiled and provides a more comprehensive record of performance and cost of the technologies. Participating agencies include DoD, the U.S. Army Corps of Engineers, the U.S. Navy, the U.S. Air Force, DOE, the U.S. Department of the Interior, and EPA. FRTR can be accessed through the Internet at ***<http://www.frtr.gov>***.

Ground-Water Remediation Technologies Analysis Center (GWRTAC). GWRTAC was established through a cooperative agreement between the National Environmental Technology Applications Center (NETAC) of the Center for Hazardous Materials Research (CHMR) and EPA. The goal of GWRTAC is to compile, analyze, and disseminate information about innovative ground-water remediation technologies to industry, the research community, contractors, government, investors, and the public. The center currently is compiling information to be included in databases of interactive case studies and vendor information that will be available on the GWRTAC Internet site. GWRTAC can be accessed through the Internet at ***<http://www.gwrtac.org>***.

Office of Research and Development (ORD). ORD, under the Acting Assistant Administrator, Henry L. Longest II, P.E., is the scientific and technological arm of EPA. Comprised of three headquarters offices, three national research laboratories and two national centers, ORD is organized around a basic strategy of risk assessment and risk assessment management to remediate environmental and human health problems. ORD focuses on the advancement of basic peer-reviewed scientific research and the implementation of cost-effective, common sense technology. Fundamental to ORD's mission is a partnership with the academic scientific community through extramural research grants and fellowships to help develop the sound environmental research necessary to ensure effective policy and regulatory decisions. ORD also implements such programs as the Superfund Innovative Technology Evaluation (SITE) program which focuses on treatment technologies and EPA's Environmental Technology Verification Program (ETV) which focuses on site characterization technologies. ORD can be accessed through the Internet at ***<http://www.epa.gov/ORD/>***.

Remediation Technologies Development Forum (RTDF). RTDF was established by EPA to foster public-private partnerships that would conduct laboratory and applied research to develop, test, and evaluate innovative remediation technologies. RTDF's home page provides access to information about various remediation technologies currently being designed, developed and evaluated through seven action teams of RTDF including: the Bioremediation of Chlorinated Solvents Consortium, the LASAGNA™ Partnership, the Permeable Reactive Barriers Action Team, the Sediments Remediation Action Team, the In-Place Inactivation and Natural Ecological Restoration Technologies (IINERT) Soil-Metals Action Team, the Phytoremediation of Organics Action Team, and the *In Situ* Flushing Action Team. RTDF can be accessed through the Internet at ***<http://www.rtdf.org>***.

Superfund Innovative Technology Evaluation (SITE) Demonstration Program. The SITE Demonstration program was established by EPA's Office of Solid Waste and Emergency Response and the Office of Research and Development to encourage the development and implementation of innovative treatment technologies for the remediation of hazardous waste sites, and monitoring and measurement. Through the program, technologies are field-tested on hazardous waste materials and engineering and cost data are gathered on the innovative technology so that potential users can assess the technology's applicability to a particular site. Data collected during the field demonstrations are used to assess the performance of the technology, the

potential need for pre- and post-processing of the waste, applicable types of wastes and waste matrices, potential operating problems, and approximate capital and operating costs. The collected information is then provided in a Innovative Technology Evaluation Report, Technology Capsule, and Demonstration Bulletin. These reports evaluate all available information on the technology and analyze its overall applicability to other site characteristics, waste types, and waste matrices. Testing procedures, performance and cost data, and quality assurance and quality standards also are presented. The SITE Demonstration program can be accessed through the Internet at ***<http://www.epa.gov/ORD/SITE>***.

Technology Innovation Office (TIO). The U.S. Environmental Protection Agency's (EPA) TIO was created in 1990 to act as an advocate for new technologies. TIO's mission is to increase the application of innovative treatment technologies to contaminated waste sites, soils, and groundwater. To meet that mission, TIO has expanded its focus from treatment technologies to include site characterization technologies in order to improve the remediation process. TIO has encouraged and relied on cooperative ventures with other partners to accomplish many of its goals. This effort to effectively use resources has led to numerous joint efforts that have enhanced the state of both remediation and site characterization. For additional information about TIO, contact Jeff Heimerman of EPA's TIO at (703) 603-7191. TIO can be accessed through the Internet at ***<http://clu-in.com/tiomiss.htm>***.

SITE CHARACTERIZATION TECHNOLOGIES

Electronic Sources of Information

EPA, National Exposure Research Laboratory - Hazardous Waste Site Characterization (on CD-ROM) (EPA 600-C-96-001). The Hazardous Waste Site Characterization CD-ROM, developed by NERL's ESD-LV, compiles guidance documents and related software to aid environmental professional in the complex, multidisciplinary, characterizing of hazardous waste sites. The CD-ROM is a compilation of computer programs related to EPA's RCRA and Superfund programs that can be printed, as well as searched by key words. Using the CD-ROM requires a personal computer with DOS Version 3.0 or higher, 640K of Ram, and 3 MB of hard disk space. A math co-processor is recommended but not required. The CD-ROM can be ordered on-line through the NTIS Internet site at ***<www.ntis.gov>***.

Field Sampling and Analysis Technologies Matrix. The matrix, developed by participating agencies of the Federal Remediation Technologies Roundtable (FRTR), is a matrix and reference guide that is intended to provide users with an understanding of the site characterization technologies available to them and the applicability of various technologies to their particular problems(s). The matrix provides a general understanding of state-of-the-art technologies for site characterization. The matrix and reference guide also enhances technology information transfer and provides much needed comparison among competing technologies. The matrix can be accessed through the Internet at ***<http://www.frtr.gov/site>***.

Hazardous Waste Clean-Up Information (CLU-IN) Home Page. CLU-IN is a streamlined source of information about innovative remediation and site characterization technologies for hazardous waste cleanup professionals. It provides access to information about programs, organizations, publications, and other tools for EPA and other Federal and State personnel, consulting engineers, technology developers and venders, remediation contractors, researchers, community groups, and individual citizens. Access to various tools of information is presented in the form of downloadable publications and databases. Sources of additional information on the Internet also are presented through a series of links. CLU-IN is sponsored by EPA's Technology Innovation Office (TIO). For additional information about the CLU-IN home page, call (301) 589-8368. CLU-IN can be accessed through the Internet at ***<http://clu-in.com>***.

TechDirect. TechDirect, hosted by EPA's TIO, is an information service that highlights new publications and events of interest to environmental professionals. Information about site characterization and remediation technologies are available through this Internet subscription service. Approximately once a month, the service distributes by electronic mail, a message describing the availability of publications and announcements of events. For publications, the message explains how to obtain a hard copy or how to download an electronic version from the Internet. For additional information about TechDirect, contact Jeff Heimermann at (703) 603-7191 or by E-mail at *heimerman.jeff@epamail.epa.gov*. TechDirect can be accessed through the Internet at ***<http://clu-in.com/membersh.htm>***.

Vendor Field Analytical and Characterization Technologies System (Vendor FACTS), Version 3.0. Vendor FACTS, Version 3.0 is a Windows ™-based system that contains information provided by vendors on field-portable technologies for measuring and monitoring contaminated soil and groundwater. Some

of the technologies listed in the system are air measurement technologies, analytical detectors, gas chromatography equipment, chemical reaction-based indicators, immunoassay instruments, and soil-gas analyzers. The system allows users to screen technologies by such parameters as contaminant, medium, or development status. The system is available on compact disk and requires a 486 IBM-compatible computer running MS Windows 3.1 or MS Windows 95, a minimum of 8 MB RAM, and 27 MB of free disk space. The database can be downloaded free of charge from the CLU-IN Internet site at ***<http://clu-in.com/pubibase.htm>***.

Programs, Partnerships, and Organizations

Consortium for Site Characterization and Technology (CSCT). CSCT was established as one of 10 pilot projects currently implemented by EPA's Environmental Technology Verification (ETV) Program. The CSCT is a partnership program among the U.S. Environmental Protection Agency (EPA), the U.S. Department of Defense (DoD), and the U.S. Department of Energy (DOE) that is responsible for evaluating and verifying the performance of innovative site characterization technologies. The CSCT provides support to technology developers, evaluates and verifies data generated during demonstrations, and develops and disseminates information about the performance of site characterization technologies. CSCT can be accessed through the Internet at ***<http://clu-in.com/csct.htm>***.

Environmental Technology Verification Program. The ETV program seeks to provide credible performance data on environmental technologies from independent third parties under the auspices of EPA. It verifies the performance of innovative technical solutions to problems that threaten human health or the environment. Managed by EPA's ORD, ETV was created to substantially accelerate the entrance of new environmental technologies into domestic and international marketplaces. It supplies buyers of technologies, developers of those technologies, consulting engineers, states, and EPA regions with high-quality data on the performance of new technologies. ETV expands on past verification efforts, such as those conducted under the SITE program for remediation technologies. ETV currently implements 10 pilot projects, including the Consortium for Site Characterization Technology (CSCT). The ETV program can be accessed through the Internet at ***<http://www.epa.gov/etv/plt-02.htm>***.

EPA Library Network Program. The EPA National Library Network Program is a repository of information from EPA's Headquarters, Regional and Field Offices, Research Centers, and specialized laboratories throughout the country. The Library Network provides access to its collection through the On-line Library System (OLS), a menu-driven database of the library's holdings. The OLS provides users with the ability to perform online searches by author, title, or keyword. The material on OLS is updated every two weeks. The EPA National Library Network Program can be accessed through the Internet at ***<http://www.epa.gov/natlibra>***.

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Report, Technology Capsule, and Demonstration Bulletin. These reports evaluate all available information on the technology and analyze its overall applicability to other site characteristics, waste types, and waste matrices. Testing procedures, performance and cost data, and quality assurance and quality standards also are presented. The SITE Demonstration program can be accessed through the Internet at ***<http://www.epa.gov/ORD/SITE>***

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